FACTORS AFFECTING THE HEDGING DECISION OF FARMERS: THE CASE OF MAIZE FARMERS IN GAUTENG PROVINCE

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DECLARATION

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ABSTRACT

Maize is the most important field crop in South Africa. It is used for both animal feeds and human consumption. It is also used by many industries as an input, is a source of foreign exchange and of employment opportunities for many people in the country. It is an important component of the agricultural sector, plays an important role in the economy and presents opportunities in terms of agricultural investment and employment creation.

The maize industry in South Africa has long history of government intervention where the price of maize was set by government through the office of the Minister of Agriculture. This was fuelled by the two Marketing Acts (of 1937 and 1968). During the period of these Acts, farmers were not exposed to international markets. However after the introduction of the Marketing of Agricultural Products Act (Act 47 of 1996), farmers have been exposed to international maize prices, i.e. to the forces of supply and demand. Farmers are no longer guaranteed a maize price during the beginning of the production season, and now have to use different methods to protect their income against a volatile maize price. Through forward contracting (hedging) their maize, farmers can minimize the price risk that they are facing. A number of instruments have been developed to assist farmers to protect themselves against price risk. In South Africa, SAFEX is used to reflect the expected future price of maize and it can be used by farmers as a reference for the expected price.

Different factors affect the hedging decisions of farmers. The main objective of this study was to identify factors affecting the hedging decision of maize farmers in Gauteng, and hence their rate of adoption of hedging strategies. The study employed a number of methods in an effort to answer this question. Data analysis relating to factors affecting the hedging decision of the farmers was carried out using Excel and the SPSS statistical package and took the form of multiple cross tabulation. A Probit regression equation was estimated using the SPSS 20 statistical software package.

In the case of the adoption rate of hedging by maize farmers in Gauteng, it was found that only 35 per cent of the maize farmers forward contract their maize against price risk. This implies that they are not protecting their income against price volatility through forward contracting.

The results show that the factors that have the most influence on the decision whether to hedge are: the gender, age, and agricultural qualification of the principal decision maker; whether the decision maker is a member of a grain association and the size of that grain association; the length of period that the decision maker has been producing grain; the size of the farm; whether the farmer rents in

land; the proportion of off-farm income earned and whether the farmer takes out insurance. These variables are all statistically significant at the 5 per cent level.

OPSOMMING

Mielies is die belangrikste akkerbougewas in Suid-Afrika. Dit word gebruik vir beide dierevoere en menslike verbruik. Dit word ook in baie bedrywe as ’n inset gebruik, vorm ’n bron van buitelandse valuta en verskaf werksgeleenthede aan baie mense in die land. Dit is ’n belangrike komponent van die landbousektor, speel ’n belangrike rol in die ekonomie en verskaf geleenthede in terme van landboubelegging en werkskepping.

Die mieliebedryf in Suid-Afrika het ’n lang geskiedenis van regeringsingryping waardeur die prys van mielies deur die regering, by name van die kantoor van die Minister van Landbou, vasgestel is. Dit is aangevuur deur twee Bemarkingswette (van 1937 en 1968). Gedurende die tydperk van hierdie wette is boere nie aan internasionale markte blootgestel nie. Met die aanvang van die Wet op die Bemarking van Landbouprodukte (Wet 47 van 1996) is boere aan internasionale mielieprys blootgestel, m.a.w. aan die kragte van vraag en aanbod. Boere word nie meer aan die begin van die produksieseisoen ’n mielieprys gewaarborg nie, en moet nou ander maniere vind om hulle inkomste teen ’n onbestendige mielieprys te beskerm. Deur die koop van termynkontrakte op hulle mielies (verskansing) kan boere die prysrisiko’s wat hulle in die gesig staar, minimaliseer. ’n Aantal instrumente is ontwikkel om boere te help om hulleself teen prysrisiko te beskerm. In Suid-Afrika word SAFEX gebruik om die verwagte toekomstige prys van mielies te weerspieël en dit kan deur boere as ’n verwysing na die verwagte prys gebruik word.

Verskeie faktore beïnvloed die verskansingsbesluite van boere. Die belangrikste doelwit van hierdie studie was om faktore te identifiseer wat die verskansingsbesluit van mielieboere in Gauteng beïnvloed, en dus die tempo waarteen hulle verskansingstrategieë in gebruik neem. Die studie het ’n aantal metodes gebruik in ’n poging om hierdie vraag te beantwoord. Data-analise m.b.t. die faktore wat die verskansingsbesluit van die boere beïnvloed, is met Excel en die SPSS statistiese pakket uitgevoer en het die vorm van meervoudige kruistabellering aangeneem. ’n Probitregressievergelyking is met behulp van SPSS 20 statistiese sagteware beraam.

In die geval van die tempo van aanneming van verskansing deur mielieboere in Gauteng is daar gevind dat net 35 persent van die mielieboere termynkontrakte op hulle mielies gebruik om hulle teen prysrisiko te beskerm. Dit impliseer dat hulle nie hulle inkomste teen onbestendige pryse beskerm nie.

Die resultate toon dat die faktore wat die grootste invloed het op die besluit om te verskans die volgende is: die geslag, ouderdom en landboukwalifikasie van die hoof besluitnemer; of die besluitnemer ’n lid van ’n graanvereniging is, en die grootte van dié graanvereniging; hoe lank die besluitnemer reeds graan produseer; die grootte van die plaas; of die boer grond inhuur; die proporsie van inkomste wat weg van die plaas af verdien word; en of die boer versekering uitneem. Hierdie veranderlikes is almal statisties betekenisvol by die 5 persent vlak.

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CHAPTER 1: INTRODUCTION

1.1 Background information

South African agriculture has a long history of government intervention with a series of laws, ordinances, statutes and regulations affecting all aspects of agriculture (Kirsten and Van Zyl, 1996). The new Marketing of Agricultural Products Act (No 47 of 1996) was promulgated at the end of 1996. Prior to this the grain industry was inwardly focused and heavily influenced by regulations and government control (Doyer *et al*., 2007). For example in the past the Maize Board determined producer prices and acted as a single channel marketer, but from 1996 the grain market has been free from statutory intervention (Phukubje and Moholwa, 2006). Prices are now determined by the interaction of supply and demand.

The deregulation of agricultural marketing created the need for South African producers to give more individual attention to managing price risk. While producers may feel they have some influence on yield through their decisions, prices are beyond their control (Newbery and Stiglitz, 1981). Agricultural marketing policy is now operating in a more open and transparent system (Phukubje and Moholwa, 2006). According to Doyer *et al.* (2007) the deregulation of the South African agricultural sector commenced in the 1980s and gradually changed the structure and responsibilities of the actors in the sector. This process of deregulation and liberalization exposed farmers and agribusiness alike to international forces. The dynamic environment in which farmers operate urges the need to understand the production and consumption patterns of the product they produce (Meyer, 2005).

The deregulation of agricultural markets in South Africa has led to the establishment of a futures market for agricultural commodities, which was opened in January 1995. Maize was traded from the start, allowing role-players in the industry the opportunity to manage price risk. The introduction of options contracts further advanced price risk management for all market participants (SAFEX APD, 2002). To date, agricultural commodities traded on the South African Futures Exchange (SAFEX) markets are white and yellow maize, wheat, sunflower seed and soybean, introduced in 1996, 1997, 1999 and 2002 respectively (SAFEX, 2007).

Maize is the most important grain crop produced in South Africa. It contributed approximately four per cent on average in the last ten years to the gross value of agricultural production (NDA, 2007).

It serves as a food source for humans and animals. It is used as an input into other sectors of the economy, a source of job creation, a contributor of value added to the national economy and an earner of foreign exchange (Vink and Kirsten, 2000).

In South Africa maize is planted between mid – October and mid – January in the summer rainfall areas. It is produced throughout South Africa with the Free State, Mpumalanga and North West being the largest producers, accounting for more than 85 per cent of production on average for the last ten years (NDA, 2009). Gauteng province is also an important producing province.

According to Troskie (2001) the grain industry is suffering from serious problems with international competitiveness, quality characteristics and the ability to adapt to a new policy environment. Yet most of the maize farmers are not using the futures market to hedge, even though the hedging instruments were developed for them to manage price risk.

1.2 Problem statement

Price risk is perceived to be a major source of risk by farmers and processors, both locally (Woodburn, 1993) and internationally (Coble and Barnet, 1999). The management of price risk is important for both processors and farmers because price variability is a major component of the overall variability in profit, and variable profits are a barrier to sound planning.

Since the deregulation of South African agricultural markets, few studies have been done about grain producers' risk perceptions and attitudes. One such study was by Ueckermann *et al.* (2008). They found that grain producers are generally less likely to hedge against uncertainty. Policy makers, commodity traders, and researchers as well as educators want to know why futures markets have failed to attract greater farmer participation, because they believe that the futures markets were developed to offer price insurance for farmers. It allows the farmers to reduce the risk of price volatility in agricultural commodities, because commodity (including maize) prices in general are known to be very volatile (Geyser and Cutts, 2007). Futures contracts are tools that the farmers can use to mitigate the risk of unfavourable price movements.

The main objectives of this study are to determine which factors affect hedging decisions and to investigate the adoption rate of hedging against price risk by farmers in the maize industry in Gauteng. To simplify the analysis, the main problem will be divided into four sub-problems:

- The first sub-problem is to investigate the adoption rate of hedging against price risk by maize farmers in Gauteng province.
- The second is to identify the farm and owners' characteristics that affect the hedging decisions of farmers
- The third is to identify the alternative means of reducing price risk
- The fourth is to enhance the understanding of independent maize producers' decision making behaviour.

Adoption rate of hedging against price risk by farmers

As there are only a few studies that have been done in South Africa on the hedging decisions of farmers, international studies have been reviewed to seek guidance. The international studies which investigate the use of forward pricing behaviour of farmers have found that few farmers actually use forward pricing as price risk management tool. Asplund *et al.* (1989) found that 49 per cent of 353 Ohio grain producers surveyed of the respondents use hedging. Goodwin and Schroeder (1994) in a survey of 509 Kansas producers found that 45 per cent use hedging to manage price risk in their farming operation. Bown *et al.* (2000) investigated South African maize producers use of forward pricing methods and found that 47.1 per cent of respondents use some form of forward pricing arrangement during 1998/99. Jordan and Grove (2007) investigated South African maize producers' forward pricing behaviour during the 2004/05. They expected an increase in the number of farmers who participated in forward pricing owing to a learning curve effect. However they only found that only 44 per cent of their respondents participate in some form of forward pricing. Given the importance of hedging, the adoption rate of hedging against price risk in South Africa is still lower than expected (Jordaan and Grove, 2001). Why is the adoption rate still lower than expected even 15 years after deregulation of the agricultural markets? This background leads to the second sub-problem.

Maize farm and owner characteristics

This sub-problem will be divided into two parts for simplicity of analysis, namely maize farm characteristics and maize farmer characteristics

First, the purpose is to identify the maize farm characteristics that affect the hedging decisions of farmers in Gauteng. Hedging is the process of shifting price risk in the cash market to the futures market by simultaneously holding opposite positions in the cash market (Knight *et al*., 2003). Farmer's exposure to the maize price has increased since the deregulation of the market in South Africa. South African maize producers have since 1997 been able to hedge against price risk on the South African Futures Exchange (SAFEX). Based on the literature, it is hypothesised that factors such as size of the maize farm has a positive influence on the hedging decisions of maize farmers.

Second, the purpose is to identify the characteristics of the maize farm owner/manager that affect the decision to hedge. These attributes are assumed to be related to the experience, educational level, marketing skill and age of the owner or manager. It is hypothesised that the level of education, access to information, experience in maize farming and marketing skill are positively related to the decision to hedge. For example, the age of the owner or manager of a maize farm is hypothesised to be inversely and directly related to the hedging. This is based on the assumption that the younger the maize farmer or owner, the greater the chance of being innovative and proactive, hence the greater the chance of hedging. On the side of old farmers it is also expected that they will hedge as they do not want to take risk of losing their income as they cannot be employed somewhere else. Also a farmer is expected to hedge a larger proportion of his or her crop if the farmer has a good perception of forward pricing in price risk management.

Identify the alternative means of reducing risk

The research hypothesised that the use of alternative means of reducing risk are expected to influence the hedging decisions of farmers or owners, since it influences the overall decision of investment in farming (Bown *et al*., 1999). If the alternative risk management tool is used to complement hedging, the expected relationship will be positive, while if the alternative risk management tool is used to substitute hedging the expected relationship will be negative. In this study only four alternative risk management tools are hypothesised to influence hedging decisions, namely crop insurance, off farm economic activities, the level of diversification, and whether the farmers have their own storage or whether they use the local cooperative silo.

Enhance the understanding of independent maize producer's decision making behaviour

The researcher hypothesised that the farmers do not believe that the forward pricing market is effective. This might be the result of misunderstanding of how this market works. Therefore education should focus more on the practical application of hedging methods and not purely on the benefits of the use of hedging (Jordaan and Grove, 2007). It is important for the farmers to understand the practical side of hedging and how it works. To achieve this, this study will provide a more in-depth explanation of the specific aspects of hedging. It will be unique in providing the stakeholders with a concise, yet readable overview of the futures market and maize industry.

1.3 The limitations

The study will only consider the maize farmers in the Gauteng province. Gauteng is the fourth major producer of maize in South Africa, and is part of the so-called maize triangle. It is assumed that the maize farmer will hedge or not hedge. Generally the more the data the better, as this increases the number of observations and thus the degrees of freedom. The main unit of analysis is the maize farm and owner characteristics and alternative means of reducing price risk. The study also only focuses on the price risk, while maize farmers also face a number of other sources of risk such as plant diseases, extreme weather occurrences and farm murders. In this study maize refers to both white and yellow maize.

1.4 Motivation for the study

Price risk was identified as a major source of risk during the development of the strategic plan for South African agriculture in 2001 by the National Department of Agriculture (NDA) jointly with AgriSA. Price risk might result in acute economic, social and political consequences (Timmer, 1995; Collier and Dehn, 2001), therefore effective management of price risk may reduce these negative consequences, while it is also important to enhance competitiveness and the profitability of agriculture (NDA, 2001). This shows that, clearly, effective price risk management is of national importance in South Africa. However, individual farmers too may benefit if they manage price risk effectively since price risk is a substantial component of the overall variability in profit (Groenewald et al., 2003).

Farms and farmer characteristics have a significant impact on decision making in the agricultural sector, and they also affect the hedging decisions of farmers. The depressing effect resulting from these characteristics hampers the agricultural sector's potential to act as a catalyst for growth. An understanding of these characteristics is important for the sustainability and growth of the maize industry in South Africa.

Role players in the maize and grain industry as a whole will be able to use the results of this study to advise maize producers on the use of forward pricing methods in price risk management and consequently will also add more value to farmers on the use of forward pricing methods in price risk management, and enhance their thinking about futures markets. However the results of this study may also be used by decision-makers (policy makers, managers, etc.) to make informed decisions.

1.5 Chapter outline

This chapter (chapter 1) provides the background, problem statement, research questions, study delimitation, as well as importance of the study. Chapter 2 provides a broad overview of related and relevant research. Chapter 3 gives an overview of the maize industry, while Chapter 4 focuses on the research method. Chapter 5 presents the results and analysis (including interpretation) and Chapter 6 concludes, together with recommendations for stakeholders and further research.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Maize producers know how to manage their production risk but unfortunately the necessary protection is not always in place in terms of price risk. The price of maize is controlled by supply and demand; therefore volatile prices of maize bring volatility to farmer incomes, to margins in the supply chain, and to consumer prices. Exposure to the risk of unpredictable price fluctuations is a major economic problem for maize producers. The futures market provides an opportunity for maize producers to reduce the risk of fluctuation in cash prices by hedging. Hedging is the process of shifting the price risk in the cash market to the futures market by simultaneously holding an opposite position in the cash market (Knight, *et al.*, 2003).

The objective of this chapter is to present a theory of hedging and review empirical studies relating to factors affecting the hedging decision of maize farmers. Little attention has been paid by researchers to the South African maize producers' risk perception and risk attitudes, therefore international studies will be review to seek guidance. However due to the little publicity of specific literature, this chapter will rely also on general literature.

2.2 The theory of hedging

Futures markets are important for the hedger, because it they are used to reflect expected future prices. Therefore this section will start with a brief overview of the forward and futures contract.

2.2.1 Forward and futures contracts

According to theory, markets for futures transactions are markets for contracts to future spot transactions. Burns (1979) reported that such markets entail a means of effective contracts to future transactions in commodities as well as a way of collecting and disseminating information on the terms of such contracts. He added that market forces determine both the types of contracts for future transactions and the maturity limits of those contracts. He further added that it should be recognized that market forces operate in a particular institutional framework, including regulatory and other governmental policies.

Contracts for future spot transactions may be of two types. First, they may consist of rights and obligations to spot transactions in the future. Second, they may consist of the purchase of a right but not an obligation to such a transaction (commonly referred to as an option contract). The actual futures contract is usually regarded as the conventional contract, and it requires making or delivery of an asset at a specified date in the future. In particular, Burns (1979) defines a futures contract as an agreement between two parties, one to buy and the other to sell a stated quantity of a commodity of given quality for delivery at a future date (or over a period of time) at a specified price and at a specified location.

According to Siegel and Siegel (1990), it is easier to understand futures contracts if one first learns about forward contracting. Futures contracts are fundamentally similar to forward contracts in that they too establish a price today for a transaction that will take place in the future. Siegel and Siegel (1990), define the forward contract as an agreement between buyer and seller that has the following characteristics:

- It specifies a quantity and type of commodity or security to be bought or sold at a pre-specified future date
- It specifies a delivery place
- It specifies a price
- It obligates the seller to the buyer subject to conditions and it obligates the buyer to buy.
- No money changes hands until the sale date, except perhaps for a small service fee.
- The two parties to the deal negotiate the terms of the forward contract and each side must trust that the other will not default on the contract. Often one or both parties will perform a credit check on the other party before entering into the contract.

While futures and forward contracts are fundamentally similar, there are still some important differences between the two types of contract. First, futures contracts specify standardized quantities and delivery dates while forward contracts are customized to meet the needs of the two parties (Chance, 2004:3). Second, futures contracts are traded in centralized and established exchanges (in South Africa on SAFEX), while forward contracts are traded between dealers. Third, to enter into a future contract one must simply put a certain per centage of the face value into an account, called a margin account, with a broker, while to enter into a forward contract one must usually set up a credit line with the dealer. Finally, futures contract are regulated, while forward contract are unregulated.

According to Chance (2004:5), the earliest market for future transactions were forward markets in which two parties negotiated a tailor-made contract, and the development of such contracts may be traced back some seventeen centuries. Subsequently, highly organized or futures markets emerged. Future markets are the most widely known markets for contracts to future spot transactions, operating through organized exchanges. Futures markets emerged in the nineteenth century. The contract explained above are used to hedge against the price risk. But the question is why the hedging is so important for producers and users of agricultural commodity? The following section will explain the role of hedging.

2.2.2 The role of hedging

Many authors have highlighted the important function of hedging using the forward pricing method. According to Pennings and Leuthold (2001), in the traditional view futures exchanges have two main functions: risk reduction and price discovery. They reduce the risk of price volatility and discover the price of the commodity at a certain level. Pennings and Leuthold (2000) have argued that futures markets provide other services as well. They defined these as a service through which a firm is offered the opportunity to buy or sell products forward at a fixed price, thereby not restricting the firm to engage in a cash contract relationship. Pennings and Leuthold, (2001) supported the statement of price fixing by saying a futures position has two important consequences. Firstly, by fixing the price in advance you reduce the spot market risk and secondly fixing the price in advance at a certain level is inherent in taking a futures position. Working (1953) also provided an alternative explanation for the motivation to hedge, stating that the use of futures gives the manager greater freedom for business action. He argued that the freedom gained could be used to make a sale or purchase that would not be possible in the cash market. This was found by Pennings and Leuthold, (2001) to be in line with the findings in the management studies (e.g. Brandstatter, 1997) showing that managers value instruments that increase their degree of freedom of action in the market place.

The literature (e.g. Anderson and Danthine, 1983; Lapan and Moschini, 1994) also indicates that hedging with futures or forward contracts will benefit producers by offsetting their price risk, i.e. it protects profits against falling prices for expected output. For maize producers, hedging involves selling expected maize production through the futures contract that expires sometime in the future. The futures contract is either offset by purchasing back the same contracts prior to expiration or being cash settled at contract expiration. Option contracts are another marketing tool that can be

used to protect a producer against a falling maize price. A put option gives the producer the right but not the obligation to sell a futures contract for a certain price by a certain date. Put options are typically used by producers to lock in a minimum floor on their forward price. This price floor is designated by the strike price the producer selects. For every maize futures contract there is a range of strike prices that are available when purchasing a put option. Thraen (2002) stated that a put option protects the producer against downside price risk. He elaborated by saying if the producer uses a put option to place a floor (the strike price) on his product price and the futures price falls below the strike price, then the put option is exercised by selling futures contracts at the specified strike price but if the future price keeps falling the futures contracts may be purchased back at a lower price than the strike price. This shows that the producer is protected against the futures price falling below the strike price. If the futures price does not fall below the put option strike price, then the option expires worthless to the producers. This shows the ability of the futures market to offer price insurance.

Economic theory provides several explanation of hedging. According to Aretzs *et al.* (2007), hedging can alleviate underinvestment and asset substitution problems by reducing the volatility of cash flow and it can accommodate the risk aversion of undiversified managers and increase the effectiveness of managerial incentive structures through eliminating unsystematic risk. They further added that the lower volatility of cash flows also leads to bankruptcy costs. For example, a farmer who is growing maize and is planning to sell it in six months cannot be certain about what the price of maize will be in six months. It may be lower or higher than expected or anticipated at planting. If the price turns out to be significantly lower, the farmer may be forced to sell at a price which does not cover production costs, and the result may be bankruptcy. Moreover, the authors add that hedging can also align the availability of internal resources with the need for investment funds, helping business to avoid costly external financing.

2.2.3 Limitations of hedging

The maize producer can hedge against the price risk but cannot hedge against quantity risk. Even if the producer can anticipate the price of maize correctly, or successfully hedge price risk, he or she can also experience quantity risk – e.g. if the maize farmer anticipated growing 5 000 tons of maize, but due to unfavourable conditions (e.g. weather) only managed to harvest 3 000 tons. This type of risk is called quantity risk: uncertainty about the quantity that will be sold or bought at some future date. It is unfortunately not a risk that can be hedged with great precision with futures, options or

any other existing forward pricing instrument. Nevertheless the objective of this section is not to discuss the quantity risk but to keep it in mind.

2.2.4 The objectives of hedgers

Hedgers are individuals or companies (including farming enterprises) that own or are planning to own a cash commodity such as maize or wheat, or government bonds, and are concerned that the price of the commodity may change before they either buy or sell it (CBOT, 1998). In the case of maize producers, the hedger is a producer who owns (maize) or is planning to plant maize and is concern that the price may change unfavourably before they can sell it. Virtually anyone who seeks to protect cash market commodities from unwanted price changes can use forward pricing for hedging to protect themselves against future unfavourable price movements.

According to Bittman (2001), there are two types of hedgers, long and short. Short hedgers are market participants who have inherently long positions and they have produced to sell. The long hedgers are market participants who have inherently short positions and they do not have produce to sell, and they want to buy from producers.

Hedger usually hedge by buying or selling futures contract to offset the risk of changing prices in the cash markets. This risk transfer mechanism makes futures contracts useful tools for controlling costs and protecting profit margins. According to Edwards and Ma (1992), the ultimate goal of any business is to make a profit. They added that the price variation in outputs and inputs is the only source of variation in revenues and costs. They further added that changes in sales revenue can occur either because of changes in prices or because of changes in the quantity sold.

Markets do not always move as expected, and prices could move in the hedgers favour, or the opposite could also happen. The loss on the hedgers' futures position would more or less offset the gain made in the cash market. Hedgers accept that possibility, even though it may mean forfeiting the opportunity to gain in the market. To the experienced hedgers, it is more important to protect a basic business investment or regular profit margin rather than risk losing it in pursuit of every cent of extra profit.

2.2.5 Strategy for hedging

Hedgers use the futures market to protect their business from adverse price changes, provided there is a related futures contract such as an option or a forward contract. Hedging with a futures contract requires a two-step process. Depending on a hedger's cash market risk exposure, the hedger will either buy or sell futures initially. Again, the hedge must offset that opening position before the futures contract expires by taking a second position opposite to the initial one. The position opening and closing trades must involve the same commodity, number of contracts and delivery.

According to Giddy (Undated), the issue of whether or not to hedge price risk continues to baffle many corporations. He added that at the heart of the confusion are misconceptions about the risk, concerns about the cost of hedging and fear about reporting a loss. A lack of familiarity with hedging and strategy compounds this confusion. Much of the literature explains that an effective hedging program does not attempt to eliminate all risk, but rather attempts to transform risk into an acceptable form. The key challenge for producers might be to determine the risk that the owner or manager is willing to bear and to transform by hedging.

Groenewald *et al.* (2003:106) and Giddy (Undated) outline the six important steps below, which are designed to help risk managers determine whether or not their companies stand to benefit from a hedging program.

Step one: Identify the risk

Before management can begin to make any decision about hedging, they must first identify all of the risks to which the enterprise is exposed. These risks will generally fall into two categories: operational risk and financial risk. [1]Edwards and Ma (1992:103) argue that quantity risk cannot be hedged, because it is not traded on futures, options or any other existing forward pricing instrument. The second type of risk, price risk, is the risk that producers face due to exposure to market forces. Price risk, for the most part, can be hedged due to the existence of large, efficient markets through which this risk can be transferred.

[1] It must be noted that this source is more than 20 years old, and currently there is weather-indexed crop insurance for farmers to cover expected quantity.

Step two: Distinguish between hedging and speculating

According to Giddy (Undated), the reason that risk managers are sometimes reluctant to hedge is because they associate the use of hedging tools with speculation. Speculation is the mechanism in which traders try to profit from buying or selling futures and/or options contracts by anticipating future price movements (CBOT, 1998). They believe hedging with futures introduces additional risk, while in reality the opposite is true. A properly constructed hedge always lowers risk. It is by choosing not to hedge that managers regularly expose their companies to additional price risk.

Step three: Decide how much to hedge

Hedgers may not be able to eliminate all the price risk by hedging; they also have to keep in mind that there is quantity risk (uncertainty over the size of maize) that is involved. Therefore they have to decide on how much to hedge. According to Edward and Ma (1992), this decision depends upon a hedger's risk preference. They add that the less you hedge the more risk you assume, because you became more exposed to price risk. In addition the hedger who has a strong belief about the future direction of price movements may alter their hedging strategy to reflect those beliefs. Therefore the person who assumes risk is referred to as a speculator (Edward and Ma, 1992).

Step four: Evaluate the cost of hedging in light of the costs of not hedging

The cost of hedging can sometimes make risk managers reluctant to hedge. Yet the alternative has to be considered. Derivatives tend to be cheaper because of lower transaction costs that exist in highly liquid forward and option markets (Edward and Ma, 1992:163; Groenewald *et al.*, 2003).

Step five: Do not base a hedging programme on market view

Giddy (Undated) further states that many corporate risk managers attempt to construct hedges on the basis of their outlook for interest rates, the exchange rate or some other market factors. However the best hedging decisions are made when risk managers acknowledge that market movements are unpredictable. A hedger should always seek to minimize price risk. It should not represent a gamble on the direction of market prices.

Step six: Understand the Hedging tools

This was identified as the final factor that deters many corporate risk managers from hedging. Lack of familiarity with derivative products was found to be the factor that contributes most to the reluctance to use forward contracts. Some managers view derivatives as instruments that are too

complex to understand. The fact is that most derivative solutions are constructed from two basic instruments: forwards (Swaps, Futures, etc.) and options (Caps, Floor, Calls, Puts, etc.)

2.3 Related studies

The literature contains many examples of studies that have investigated the factors affecting decision making in agriculture/farming in South Africa and elsewhere. Therefore studies reviewed in this section were conducted not specifically for maize but for other crops including maize.

Shapiro and Brorsen (1988) conducted a study that sought to determine the factors that explain why a sample of Indiana farmers uses futures markets. These authors tested their hypothesis with a sample of Indiana corn and soybean farmers. They viewed the hedging decision as a technology adoption model decision, which suggests a Tobit regression model as the empirical model. The data for the study were obtained from a survey of the participants in the 1985 Top Farmer Crop Workshop at Purdue University who were introduced to innovative technologies and management practices to help them improve the profitability of their farm business. They found that 63 per cent of the participants' hedge against price risk and they also found that significant factors related to hedging for their sample include years of experience managing a farm, years of formal education, self-rating of farm management ability, self-perceived debt position, farm size, off farm income, a positive perceived change in income and income stability due to hedging. The alternative means of reducing price risk of forward contracting, crop insurance, and government programs were not statistically significant. Furthermore, they found that differences in the level of hedging are most affected by differences in beliefs about the ability of futures markets to provide income stability. Education specific to the futures market, such as classes or seminars, was not significantly related to hedging for the farmers. Thus lack of understanding of futures does not explain the reason for differences in the use of hedging by those farmers, as most if not all understood futures. Bad experience with futures was also not significantly related to hedging.

Makus, *et al*. (1990) investigated factors influencing farm level use of futures and options in commodity marketing. They also used a Tobit model to quantify factors influencing the probability that a selected group of agricultural decision makers (producers and landowners receiving crops from a share lease) used futures or options for commodity marketing during the 1986, 1987 or 1988 marketing year. Respondents were selected from participants in an orientation session associated with a nationwide futures and option marketing pilot program. Their results suggest that previous

use of cash forward contracting, location, size and farming operation (measured by gross farm sales), having a college degree(s), and membership in a marketing club had the greatest impact on the probability of using futures and options.

Sartwelle *et al.* (2000) conducted a study determining how individuals' characteristics impact their use of alternative cash, forward, and futures and options oriented grain marketing tools through the pre-harvest, harvest and postharvest period. The primary data were collected from sampled marketing decision makers from Kansas, Iowa and Texas in 1998 through the post. Two-limit Tobit and multinomial logit economic models were use in the analysis. The results of this study indicated some personal and business characteristics have a significant impact on individuals' grain marketing practices. Significant factors were geographic location, both the absolute and relative size of crop acreage, grain enterprise specialization, years of farming experience, the use of commercial and on-farm grain storage, proximity to major grain demand centres, and the use of crop insurance.

Isengildina and Hudson (2001) conducted a study determining producer's hedging behaviour in their framework of their overall marketing behaviour, determining the motivating factors in the choice of a primary marketing strategy by cotton producers and identifying the characteristics of cotton producers that are more likely to use direct hedging to forward price their crop. Forms of forward pricing included in the analysis were forward contracting and marketing through pools (cooperatives) and hedging in the futures and options markets. The primary data were collected from randomly sampled cotton producers in respective states of the United States (U.S). A multinomial logit model was used for empirical estimation. The most important factors that explained the use of forward pricing were producer preferences, farm size, use of crop insurance, risk aversion and off-farm income. Risk aversion, off-farm income, crop insurance and some producer perceptions were important in the choice of the form of forward pricing.

A few years after deregulation of agricultural markets in South Africa, Bown (1999) investigated South African maize producers' use of forward pricing. The researcher showed that 4.7 per cent of respondents used some form of forward pricing arrangements during 1998/99. The results of the study showed that only 15 per cent of the sample of maize producers participated directly in derivative trading through SAFEX during the same period. Given the importance of hedging, the adoption rate was low. The anticipation was that the adoption rate would increase over time due to a learning effect, because the study was conducted only a few years after the deregulation of agricultural markets. However ten years after deregulation Jordaan and Grove (2007) conducted a

study investigating the factors affecting Vaalharts maize producers' adoption of forward pricing methods in price risk management. The objective of their study was achieved by employing logistic regression to investigate the factors influencing the decision as to whether a respondent used forward pricing method during the 2004/05 season. Their results showed that the use of forward pricing is associated with lower levels of risk aversion and higher levels of human capital. Factor analysis was employed to reduce the dimensionality of the personal reasons why farmers are reluctant to use forward pricing. The results from their factor analysis showed that farmers need a higher level of human capital to use forward pricing methods and that farmers do not believe that the forward pricing market is effective. Also from the result of their study, they found that only 44 per cent of the respondents used some form of forward pricing and only 4 per cent of the respondents use futures contracts.

Simons (2002) asked the question "why do farmers have so little interest in futures markets?" He was responding to the previous studies that say the use of futures market by farmers is less than what might be expected. He found that the cause was the ability of farmers to manage their exposure by adjusting leverage. He concluded that with a fully efficient capital market, adjustment of leverage can fully supplant the use of hedging. However, Pannel, Hailu and Weersink, (2007), ague against the study of Simons (2002), by saying that there are more reasons why farmers have so little interest in the futures market. Their results show that the impact of basis risk and transaction costs on hedging was moderate, while uncertainty about production only had a minor influence on hedging. Lower price uncertainty was also found to reduce the optimal hedge and may contribute to low use of futures by some farmers. According to Pannel *et al*. (2007), farmers who have less uncertainty about price have a lower optimal level of hedging, and the farmers who have a low level of risk aversion have little to gain from hedging in terms of risk reduction. These findings support those of Simons (2002) above.

Woolverton and Sykuta (2007) conducted the study seeking to understand the role of the U.S price support programs within the producer's actual price risk management strategy decision. They wanted to understand if agricultural price support programs do create incentives against managing price risk, how will U.S producers' risk management practices change with the absence of farm programs? The study was designed as a comparative case study; a comparative of decision making in two opposing institutional environments. The decision process being analyses was the commercial maize producers' grain price risk management strategy and tool choices; the institutional environments were the agricultural marketing environments of South Africa and U.S.

South Africa represents a market-based maize marketing environment absent of producer income support policies. The U.S represents a maize marketing environment consisting of federal corn price and income support policies. The study analysis was conducted using individual primary farm data collected during on-site farm interviews in South Africa and the U.S. The study has found that producer demographics are similar across South Africa and the U.S. The U.S producers are slightly older with more experience. South African producers were being found to consider price risk management more important compare to U.S producers. South African producers were also found to consistently lock-in price for a large percentage of expected maize yield. Production decision in South African it is also found to be affected by maize price. In the U.S it appears that producers' plant irregardless of price.

Dorfman and Kardi (2008) also asked the question "do farmers hedge optimally or by habit?" The objective of their study was to investigate the role of a variety of factors in the hedging decisions of farmers on three crops: corn, soybeans and cotton. They examined the role of habit, demographics, farm characteristics and information sources on the hedging decisions made by using panel data from a survey of Georgia farmers that recorded their hedging decisions for four years on three crops. They found that habit plays a significant role in hedging decisions for many farmers. The information sources were found to have significant and large effects on the chosen hedge ratio. The farmers' education level, attitude toward technology adoption, farm profitability and the ratio of acres owned to acres farmed also play important roles in hedging decisions.

Ueckermann *et al.*, (2008) conducted a study determining specific characteristics that influence South African grain farmers' preference to hedge against uncertainty and also to highlight the difference between farmers' risk preference in the production of white maize, yellow maize and wheat. According to their knowledge was the first empirical study in South Africa with the application of a separate binary logit model for each major grain (white maize, yellow maize and wheat) commodity. Their study was focused only on three provinces in South Africa, namely the Free State, North West and Mpumalanga. Their results show that out of 517 South African grain producers in the sample, 421 or 81 per cent reflected a preference to hedge against uncertainty. They estimated that white maize farmers have a 69 per cent probability to hedge against uncertainty, whereas yellow maize and wheat farmers have probability of 47 per cent and 19 per cent respectively. Furthermore, their results show that grain farmers' preferences to adopt derivative contracting are mostly influenced by the farmers' prediction of daily grain prices and trends, farm size and various geographic characteristics. Producers located on small farms were found to be

significantly less likely to hedge against uncertainties. Climate variables, yield expectations and production patterns were also found to be some of the strongest predictors affecting a grain farmers' preference to hedge against uncertainty.

Velandia *et al.* (2009) conducted a study investigating factors that influence the adoption of risk management tools such as crop insurance, forward contracting and spreading sales, while taking into account the possibility of simultaneous utilization of multiple risk reducing instruments and the potential correlations among the adoption decisions. The primary data were collected from sampled corn and soybean farmers in Illinois, Iowa and Indiana, and were used to support multivariate probit and multinomial probit models to achieve the objectives of the study. The results showed that risk management adoption decisions are indeed correlated. Furthermore, their analysis suggested that the decision to adopt one risk management tool positively influences the decision to adopt other risk management tools. The proportion of owned acres, off-farm income level, education, age and level of business risks were found to be important factors determining the adoption of crop insurance, forward contracting and spreading sales.

2.4 Factors affecting decision making of farmers

This section will provide some literature on the factors that affect the decision making of farmers. These are divided into maize farm and maize farm owner characteristics, and alternative risk management tools. Farms characteristics are those related to the farm e.g. the size of the farm, while the owner characteristics are those that are associated with the owner of the farmer/manager. Alternative risk management tools refer to the tools that a manager/owner can use to minimise exposure to price risk.

2.4.1 Maize farm characteristics

According to Nakana (2009) farming in South Africa has traditionally been dominated by white male owners and managers. It is the case in South Africa, that the large commercial farms are still almost exclusively owned and managed by white, so that even proportionally they will dominate. Therefore white male farmers are expected to perform better in the use of forward pricing as a tool for price risk management compares to other races in South Africa.

According to Barbieri and Mshenga (2008:169) if the firm has preferential access to inputs (such as information) it will have a competitive advantage in the market. They also mention that better access to the most effective and efficient distribution channel and marketing communication media gives a business an important advantage. Lee *et al.* (2001) support this by arguing that superior access to capital and human resource translates into a cost advantage combined with the ability to produce high quality service and product to exploit niches more effectively. Groenewald *et al.* (2003: 71) found that the move towards more competitive agriculture in South Africa, unburdened by regulatory constraints, is characterized by an undersupply of relevant information in some cases and inadequate access in others. This negatively affects production, investment, financial and strategic decisions. This situation could impede the decision maker's ability to manage risk and uncertainty on different levels of the marketing process.

The size of the farm is a further important characteristic that influences the decision of the farmer to hedge (see e.g. Goodwin and Shroeder, 1994; Musser *et al.*, 1994; Mishra and Perry, 1999; Sartwelle *et al.*, 2000; Katchova and Miranda, 2004 and. Ueckermann *et al.*, 2008). These authors have all established that larger farms have a greater preference to adopt forward pricing contracts. Sartwelle *et al.* (2000) suggested that the large farms have economies of scale in terms of learning how to use marketing tools and collecting marketing information. Isengildina and Hudson (2001) further suggested that learning about alternative marketing tools is a lumpy cost and because large farms can spread this cost over a higher volume of production and enjoy a potentially large net price premium per unit of production, they are more likely to hedge.

Leverage is one of the important components of the financial characteristics of the farm (Turvey and Baker, 1989; Brorsen, 1995; Collins, 1997; Isengildina and Hudson, 2001). Most of the previous studies use the long term debt-to-asset ratio as a proxy for leverage (e.g. Isengildina and Hudson, 2001). Isengildina and Hudson (2001) also added that the debt-to-asset ratio is a more general measure of leverage, because it excludes the short-term component that varies from year to year depending on capital needs for operating expenses. They further state that the optimal hedge model suggests a positive impact of leverage on the use of forward pricing because it can provide an additional source of liquidity. However, Asplund *et al.* (1989) argue that leverage and forward pricing may be negatively correlated if a farm manager's use of debt and leverage indicate his lack of risk aversion.

2.4.2 Maize farm owner characteristics

According to Heierli and Gass (2001), education is an important tool to escape poverty, if the education system reaches the right people with the right content. Isengildina and Hudson (2001) argue that the level of education is an indication of the farmers' ability to process information and cause some farmers to have better access through their superior understanding and ability to interpret information. This is consistent with the human capital theory, which refers to the stock of skills and knowledge gained through education and experience. Olaniyan and Okemakine (2008) also added that education is an economic good because it is not easily obtainable and thus needs to be apportioned. The above statements show that the level of education is important, as it is likely to lead to the reduction of search, screening and information costs. Therefore the farmer with a high level of education is more likely to have knowledge about how futures markets work and to use forward pricing as a price risk management tool. This is also supported by many studies (e.g. Fletcher and Terza, 1986; Goodwin and Schroeder, 1994; Musser *et al.*, 1996; Katchova and Miranda, 2004; Ueckermann *et al.*, 2008) which established that education, including training in derivatives market operations, has a significant and positive association with the adoption of hedging.

Many studies (e.g. Fletcher and Terza, 1986; Asplund *et al.*, 1989; Shapiro and Brorsen, 1989; Eldeman *et al.*, 1990;, 1989; Musser *et al.*, 1996) have found that age is negatively associated with the adoption of hedging strategies. The argument is that more experienced farmers have a superior ability to use the spot market. However Katchova and Miranda (2004) found that an older farmer is significantly more likely to adopt derivative contracting relative to spot market transactions. This shows that the results of the study can have positive or negative outcomes.

According to Kant and Dow (2004), experience as a general concept comprises knowledge of or skill in or observation of something or even gained through involvement in or exposure to that thing. Therefore in this study experience is defined as the exposure of the farmer to maize farming. Davis (2005) has found that farmers who have more years of farming experience are willing to forward price a larger proportion of their crop. He argued that the experienced farmer may be in a healthier financial position, and therefore more willing to hedge. However Davis (2005) also stated that a more experienced farmer may be more accustomed to the previous regime of market regulation, therefore he may forward price at a lower level. Therefore years of experience in grain

farming can have direct or inverse relationship with the decision to hedge as well as the decision on how much to hedge.

Patric and Eisguber (1968) conducted a study of the characteristics of famers and found that farmers with high managerial ability appear to be more efficient in terms of the allocation of resources than those with low managerial ability. This could be interpreted as showing that farmers with high managerial ability will be more willing to forward contract a crop.

The perception of grain producers towards forward pricing is an important factor in influencing the hedging decision. In philosophy, psychology and the cognitive sciences, a perception is defined as the process of attaining awareness or understanding (Flanagan and Lederman, 2001). Therefore grain producers with a positive perception about the free market are expected to forward price a large proportion of their crop (see e.g. Shapiro and Brorsen, 1988; McNew and Musser, 2000; Pennings and Leuthold, 2000; Isengildina and Hudson, 2001; Ueckermann *et al.*, 2008). McNew and Musser (2000) argue that a farmer who is in favour of the free market system may perceive the forward pricing market as an opportunity to generate higher prices. Isengildina and Hudson (2001) added that producers who rank themselves high in marketing skills are more comfortable in using futures and options. Therefore grain producers with high marketing skills (knowledge about SAFEX) and those who have a good perception about the free market system are expected to forward price a larger proportion of their crop.

Jera and Ajayi (2008) reported that membership of a co-operative or commodity association increases access to productive resources such as seed, information and training. According to the literature (Fletcher and Terza, 1986; Asplund *et al.*, 1989; Scknitkey *et al.*, 1992; Katchova and Miranda, 2004; Ueckermann *et al.*, 2008) access to advisory services and information has a positive association with the adoption of forward pricing methods. Asplund *et al.* (1989) and Mishra and Perry (1999) also found that the adoption of new technology, such as computers and internet use increases the likelihood of adopting forward pricing. According to Ueckermann *et al.* (2008) South African grain producers can obtain information from associations such as Grain South Africa (Grain SA) and South African Grain Information Services (SAGIS), other market players or via media such as radio and television.

According to Randela *et al.* (2008) there is a growing body of social science research associated with the concept of social captial. They argue that the central thesis of the social capital literature is

that features of social organisation, such as networks of interaction empower individuals and groups. They further added that social capital has been linked to a variety of outcomes, such as successful entrepreneurism and successful community action or development. According to Sharp and Smith (2003) it is through networks that information and other resources can be transmitted and the existence of trust facilitates co-operative behaviour based around these networks. Therefore social organization such as membership of a business association is expected to have a positive influence on the adoption of forward pricing.

2.4.3 Alternative means of minimising price risk

Alternative means of reducing price risk influence the level at which farmers use forward pricing, since it influence the overall risk of investing in farming (Bown, Ortmann and Darroch, 1999). In this study only three alternative risk management tools have been considered on the grounds of their prominence in the literature. Crop insurance, the level of diversification and the earning of off-farm income will be used as three alternative risk management tools.

According to Coble *et al.* (2000) there are two types of crop insurance that the farmer can use as a risk management tool, namely yield insurance, which exhibits a complementary relationship with hedging, and revenue insurance, which acts as a substitute for hedging at some level of coverage. Accordingly, farmers who use yield insurance are more likely to hedge, while the farmers who use revenue insurance are more like not to hedge. However in this study the focus is in the use of insurance against natural events that can be identified and quantified. Therefore maize farmers who use yield insurance to protect their crop against natural events are more likely to hedge.

The level of diversification is also one of the alternative risk management tools that can be used by farmers to minimise their exposure to price risk. McLeay and Zwart (1998), Isengildina and Hudson (2001), as well as Sartwelle *et al.* (2000) suggest that farm diversification is measured by the per centage revenue from grain as a per centage of total revenue. They established that the greater the per centage of farm area devoted to a particular grain, the more likely it is for a farmer to participate in forward contracting.

Farmers' on-farm decisions are often influenced by off-farm commitments and income (Fernandez-Cornejo *et al.*, 2007) therefore off-farm economic activity may affect the hedging decision of farmers differently depending on the relative importance of on-farm versus off-farm income.

According to Velanda *et al.* (2009) producers with a low level off off-farm income are more likely to use forward contracting as a risk reducing instrument. Gabriel and Baker (1980) and Turvey and Barker (1989) suggested that if off-farm income is considered within a risk balancing framework, it is expected to substitute for hedging, suggesting an inverse relationship. However Asplund *et al.* (1989) suggested positive relationship because off-farm work activity by farm family members may be complementary to hedging if it is used as a response to income/price variability.

According to Sartwelle *et al.* (2000) farmers who have their own storage for their crops are less likely to forward price their crops. Maize farmers who have their own storage will not hedge, because they are not exposed to the same intensity of price risk as those who do not have their own storage capacity.

2.5 Chapter summary

In this chapter background was provided on the literature on the theory of hedging and on the factors that influence the decision of the farmer on whether to hedge. Findings from other studies relating to farm and owner characteristics and to alternative risk management tools that could be used instead of forward contracting maize were analysed. Hedging is an important instrument that producers can use to protect themselves against unfavourable price movements, although it is not advisable to use hedging to speculate about future prices.

A number of studies have been conducted about the use of forward contracting or hedging against uncertainty in agriculture. However most of these studies were not specifically focused on factors affecting the hedging decisions of the farmers. Some studies have found the adoption rate of hedging to be high while others have found it to be low. These studies have employed different models to estimate and evaluate the factors affecting decisions of the farmers.

CHAPTER 3: AN OVERVIEW OF THE SOUTH AFRICAN MAIZE INDUSTRY

3. Introduction

According to Van Zyl (2010:13) a conceptual understanding of the economic and political environment in which South African farmers operate is important in order to understand the conditions under which decisions are made and price formation occurs and how profitability and risk are influenced by agricultural policies and markets. Therefore this section will start with a historical overview of the maize industry in South Africa.

3.1 South African agricultural policies and government intervention in the maize industry[2]

The South African maize industry has a long history of government intervention, principally supported by the Marketing Act of 1937 that established marketing schemes and boards to administer them. According to Meyer (2002) this intervention reached its peak around the 1980s. During that time the maize industry was heavily regulated, but in 1996 the market was liberalized and the powers of the maize scheme as exercised by the Maize Board were abolished along with the Marketing Act itself.

Control over the maize industry was exercised in terms of the maize scheme, which was in turn enabled by the Marketing Act of 1937 (consolidated and updated in 1968). This control stretched from the farm gate to beyond the mill door. Maize farmers were guaranteed a fixed maize price at the beginning of the season irrespective of the transaction cost incurred during the delivery of the maize, and there were strict quantitative controls on imports and exports, while the Maize Board had a monopoly over imports and exports.

The maize price was generally set as follows (Meyer, 2002): the Maize Board would propose a basis price, to the Minister of Agriculture for approval[3]. Once a basic price was approved, the producer price was calculated by deducting the storage costs from this basic price. The basic price

[2] This section draws on Vink and Kirsten (2000).
[3] There was even a time when the price was approved in Cabinet.

was determined by the previous year's basic price plus any increases in production costs and the profit margin (the cost price). Cost of production surveys were also conducted regularly.

According to Hobson (2006) the isolation of South Africa from foreign markets was underpinned by the fact that 23 Control Boards were established, covering some 70 per cent of total agricultural output. The Maize Board was given the following powers over time (Groenewald, 2003:121):

- Single channel marketing, in which only the board or its agent were entitled to buy, sell or store maize;
- The fixing or regulation of the maize price (these first two powers were the reason that the Maize Scheme was referred to as a single channel fixed price scheme. This was in place up to 1987);
- The conduct of a pool, and the transfer of proceeds among pools; (after 1987 the Maize Scheme turned away from the fixed price and conducted a pool, hence it became known as a single channel pool scheme);
- Registration of traders and processors (including the right to refuse and withdraw registration);
- Registration of producers;
- Control over the erection and /or use of facilities for mass handling or storage of products;
- Fixing of transport tariffs;
- Enforcement of marketing quotas; and,
- Imposition of levies on the products.

The Act was seen as part of a larger effort to support the agricultural sector. In addition to marketing support, the state also gave preferential tax treatment, input subsidies including subsidies on fertilizers and chemicals, subsidies for irrigation investment and subsidized water provision for irrigation, and a wide range of subsidies for conservation works such as fencing, contouring, etc. (Vink and Kirsten 2000).

According to Vink and Kirsten (2000), the Marketing Act was promulgated for two main reasons. Initially there was a belief that the Act would help farmers to stand together to improve the prices they received for their produce. Secondly, it was believed that cooperation amongst farmers would cut out unnecessary duplication in marketing, which would result in lower costs of getting produce to the consumers (De Swardt, 1983 cited in Vink and Kirsten, 2000). These arguments were

premised on the belief that incomes in agriculture were lower than they should be, because of a combination of natural factors and exploitation by middlemen and sundry other speculators.

Vink and Kirsten (2000) argued that although the legislation had changed the lives of commercial farmers and excluded African farmers from access to most markets for commodities it also confirmed the "law of unintended consequences". They further added that the aims of the Act were never entirely clear as the Act itself defined its purpose as intervention in pursuit of "orderly marketing", but did not define this concept. However the Kassier Committee in 1992 argued that the Act had not been successful in achieving its aims, which could have been interpreted as facilitating orderly marketing such as keeping the maximum number of (white) commercial farmers on the land. This facilitation included efficient production, reducing the marketing margin, increasing consumption and achieving price stability.

Van Zyl (1988) showed that the main beneficiaries of the legislation were not commercial farmers in general, but a few favoured commercial farmers within the sector. He showed that the maize scheme resulted in a transfer of welfare from consumers to producers. Furthermore, small scale (African) maize farmers were doubly affected by their exclusion from the maize market, because sometimes they had to sell their maize through white farmers.

Consumers and business groups also complained that the Act furthered the interests of white commercial farmers to the detriment of black farmers and of consumers. There were also calls by some farmers to be allowed to market freely, while some farmer's organizations, businessmen and officials who had benefited from the system campaigned for its retention. This was fuelled by factors such as globalization, the establishment of a democratic dispensation and a shift of political power from commercial farmers to consumers (Van Schalkwyk *et al*., 2003).

These debates resulted in the appointment by the Minister of Agriculture of a Committee of Inquiry into the Act in 1992 (the Kassier Committee). According to Vink and Kirsten (2000) the Kassier Committee found that the goals of agricultural marketing were not clearly specified in the Marketing Acts of 1937 and 1968. The main purpose of the marketing schemes was to assist farmers in managing instability. In this regard South Africa was following an international trend towards greater state intervention in agriculture that started in the 1930s in the USA.

After the report of the Kassier Committee was submitted (in 1992), the Minister of Agriculture appointed the Agricultural Marketing Policy Advisory Committee (AMPEC), to study its recommendations. AMPEC recommended far less deregulation and the maintenance of the Control Boards. The implementation of the AMPEC recommendations continued after the democratic elections in 1994 election under the National Party Minister of Agriculture in the form of a draft marketing act which did little to change the skewed benefits under the former regime. When the National Party withdraw from the government of National Unity in 1996, a draft of what was to become the Marketing of Agricultural Products Act (Act 47 of 1996) was already being discussed within the ANC and the way was cleared for its eventual promulgation (Vink and Kirsten, 2000).

The main objective of market deregulation in South Africa was to promote competition and reduce costs throughout the maize supply chain for the benefit of consumers and farmers. This resulted in a number of changes in the manner in which the maize industry functioned: (Bayley, 2000; Cass, 2009; Geyser, 2000; Groenewald, 2000; Vink and Kirsten, 2000; Van Zyl, 2010; Maize Trust, 2011)

- The new Act paved the way for the establishment of the National Agricultural Marketing Council (NAMC), which among other things was responsible for the dismantling of all the undesired restricting regulations.
- The government became responsible for monitoring the impact of market concentration on the performance of deregulated agricultural markets. In cases where problems were identified, the government was able to implement policies to counteract these problems by means of competition legislation or sector initiatives.
- The Maize Trust was established in August 1998 after deregulation with the primary goal of promoting the South African maize industry. The assets of the Maize Board were transferred to the Maize Trust. It seeks to achieve its goal by facilitating the continuous improvement of the entire maize industry, thus ensuring that it is internationally competitive and a regional leader. It provides financial support for organizations conducting research focused on maize production and marketing. The major objective further includes the acquisition, assimilation and dissemination of market access for South African maize i.e. support for training, technical assistance and the creation of marketing assistance.
- An improvement in aggregate debt repayment by farmers; several farmers had been experiencing financial difficulties during the period of regulation.
- The cropping patterns of farmers started to change towards higher value commodities as a result of risks and prices to which farmers were exposed.

- The emergence of futures trading through the South African Futures Exchange (SAFEX) with the reference price set at Randfontein to the west of Johannesburg, and the location of a large proportion of the country's milling capacity.
- The real value of South African agricultural trade, especially exports, increased significantly, because South Africa became part of the global village.
- A substantial number of cooperatives converted into companies in order to raise capital and to adopt a more flexible and commercial outlook in a deregulated marketing environment.
- Free trade of agricultural commodities within the South African Development Community (SADC) began to provide better export opportunities to countries such as Zimbabwe and Mozambique.

This period after deregulation brought many business opportunities, but because every coin has two sides, it has also brought some challenges with respect to grain marketing. Maize producers are no longer receiving subsidies from government, import protection is much lower, and farmers now have to make sure that they stay ahead of rising input prices.

3.2 The role of the South African maize industry

Maize is the most important grain crop produced in South Africa. It contributed approximately 44% on average to the gross value of total field crops during the last ten years. It also contributed approximately 13% on average to the gross value of agricultural production during the last ten years, while field crops contribute approximately 26% to the total value of agricultural production in the past last ten years (DAFF, 2011).

Maize serves as a food for human and animals. It is also used as an input to other sectors of the economy, is a source of job creation, a contributor of value added to the national economy and an earner of foreign exchange (Vink and Kirsten, 2000).

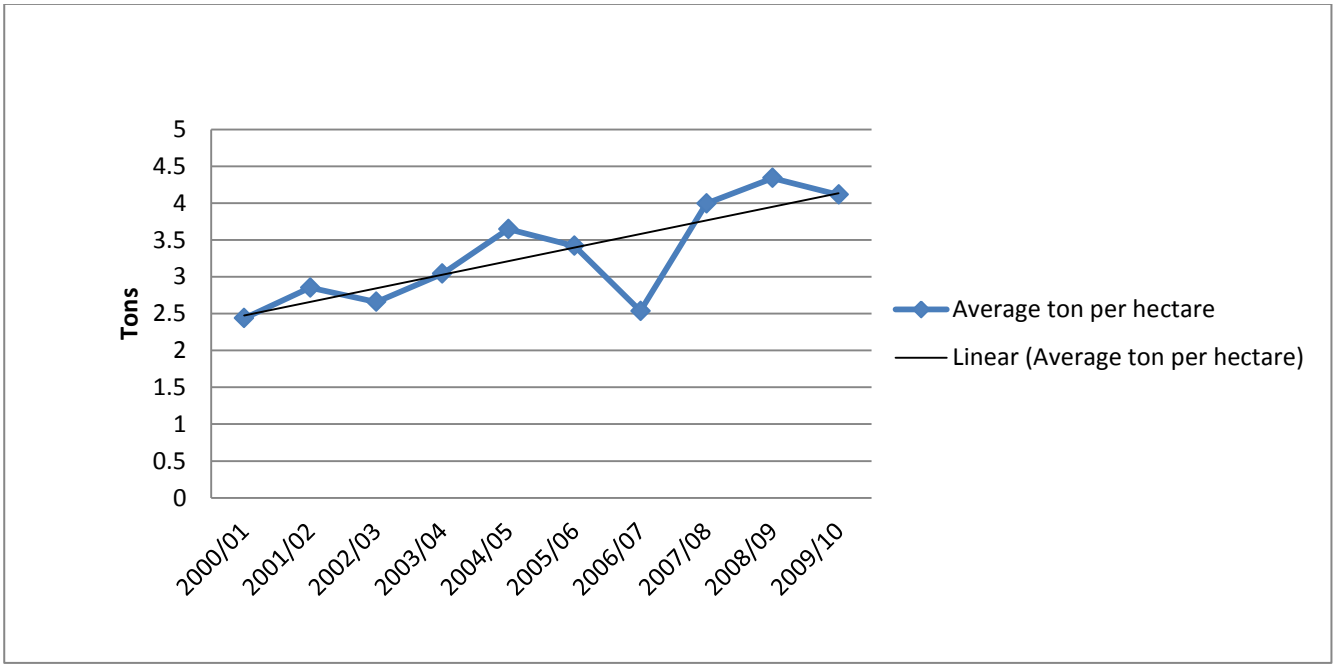
Maize is a "wage good" in South Africa. Wage goods are defined as commodities that form a large share of consumer expenditures such that their price often indirectly influences the supply of labour and wage rates. When the price of wage goods rises, industries which rely heavily on labour tend to experience rising costs, which over time creates ripple effects throughout the economy, including the erosion of that industry's competitiveness in international markets (Delgado 1992 cited in Traub and Jayne 2004:1).

3.3 Types and grading of maize

In South Africa there are two types of maize are grown, namely white maize (some 60 per cenmt of total production and consumed mostly by people) and yellow maize (40 per cent of output and consumed mostly by animals (DAFF 2011). The grading system consists of three major grades of white maize, namely WM1, WM2 and WM3 and three major grades of yellow maize YM1, YM2 and YM3. The top grades are WM1 and YM1. Grading is based not only on the primary colour of the maize, but also on the per centage of defective kernels, kernels of another colour and foreign matter in a consignment (SAFEX APD 2002:5). The current standard moisture content is 14 per cent (Malatsi, 2012)

3.4 Maize yield in South Africa

Figure 3.1 represents ton per hectare of maize in South Africa since 2000/01 to 2009/10 production year. It is evident that on average the maize yield has increased since 2000/01, apart from the drought period in 2006/07. According to NDA (2007) this increase in yield is the result of improved higher yield cultivars, good rainfall, and better production technology e.g. better land preparation methods, the withdrawal of marginal land from production and the adoption of precision farming.



Source: Data from DAFF (2011)

Figure 3.1: Average tons per hectare of maize

3.5 Major markets

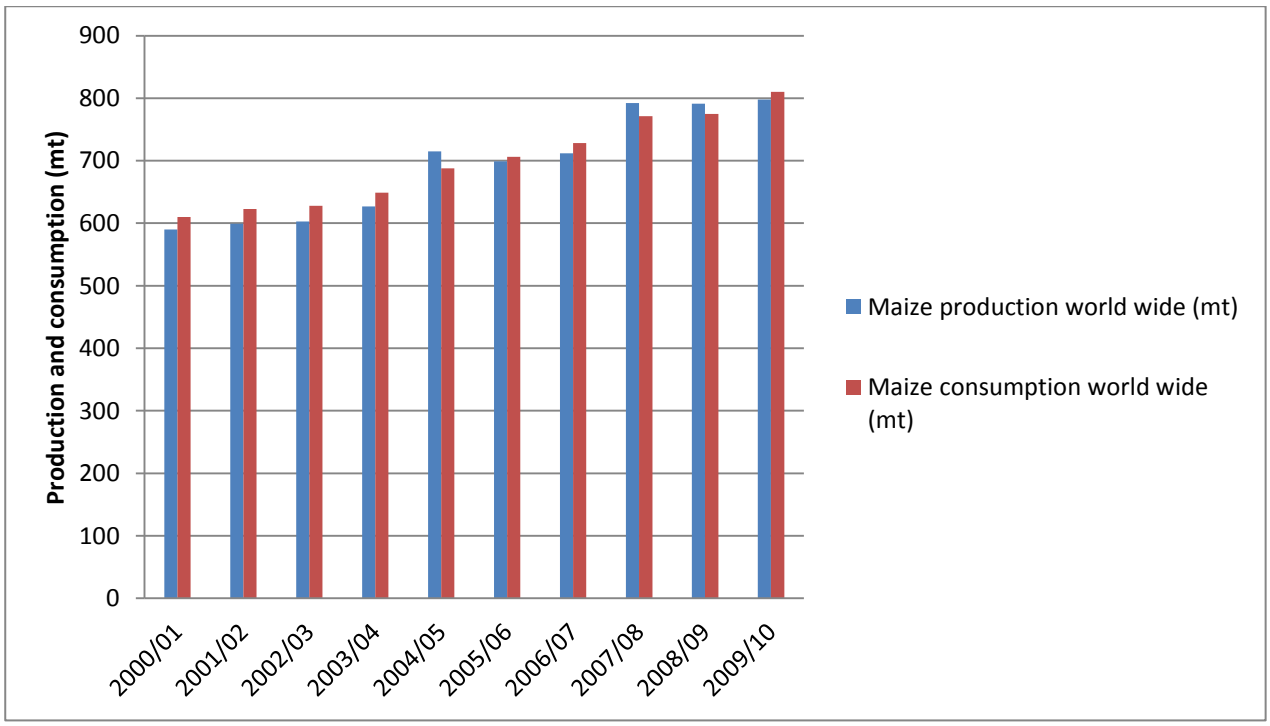
In South Africa maize is primarily sold in the form of processed products such as maize meal, maize rice and samp produced by dry milling for human consumption. The by-product of milling known as maize bran (or hominy chop) is an important feedstuff used in feedlots as animal feed (SAFEX APD 2002:6).

The wet milling industry produces starch, glucose and a wide range of starch products. Yellow maize is sold primarily for animal production and for use in the manufacture of animal feeds. During times of shortage, yellow maize has sometimes been mixed with white maize to produce a product for human consumption, but it has never been popular. When production exceeds consumption, maize is sold on the overseas and regional export market (SAFEX APD 2002:6).

3.6 World production and consumption

In the international arena, South Africa is generally ranked by the Food and Agricultural Operation (FAO, 2009) as between the ninth and fourteenth largest maize producer in the world.

Figure 3.2 shows world production and consumption during the past ten years. From 2000/01 to 2003/04 more maize was consumed than produced globally, with the result that stocks became depleted. This was again the case between 2005 and 2007, and in 2009/10. Both maize production and consumption are on a firm upward trend. This shows that the demand for maize in the world is increasing. Therefore more maize production is needed in order to remain food secured in the world.



Source: SAGIS (2011)

Figure 3.2: Annual average world production and consumption of maize (million tons)

Most of the increase in the world maize production during the past decade can be attributed to a rapid expansion in Asia. Asian maize production grew by nearly 35 per cent during the past decade, accounting for almost 30 per cent of the global increase. Both area and yield increases contributed to this high level of growth, with china making the most significant advance by contributing to as much as 60 per cent of the total gain in Asia maize production over the past decade (Abbassian, 2007).

In the world, maize is the third largest planted crop after wheat and rice. It is mostly used and traded as a leading feed crop but it is also an important food staple.

Maize crown around the world is generally categorised into two broad groups like South Africa: yellow and white. Yellow maize constitutes the bulk of total world maize production and international trade. It is traditionally used for animal feed. White maize, which requires more favourable climatic conditions for growing, is produced in only a handful of countries like the US, Mexico and in Southern Africa. White is generally considered a food crop (Abbassian, 2007).

One factor which causes serious problems for maize production from time to time is the occurrence of *El Niño*, a weather condition which is associated with abnormal warming of sea surface

temperatures in the Pacific Ocean. The maize crop that are most affected by the *El Niño* (mostly in the form of prolonged dry conditions) are largely concentrated in the Southern hemisphere, in particular in Southern Africa. During *El Niño* events of the 1980s and 1990s, for example, maize production in South Africa fell by as much as 40 to 60 per cent. However on occasion *El Niño* can also produce favourable growing conditions, thus boasting yield and production such as when its timing coincides with the critical [4]tasseling stage of crops (Abbassian, 2007).

According to Abbassian (2007) international maize economy has undergone major changes over the past two decades in terms of production, utilisation, trade as well as marketing. These changes were driven by host of factors ranging from rapid advancements in seed and production technologies, change in national policies and international trade, nearly uninterrupted expansion of feed usage across the globe and more recently the sudden surge in demand for ethanol.

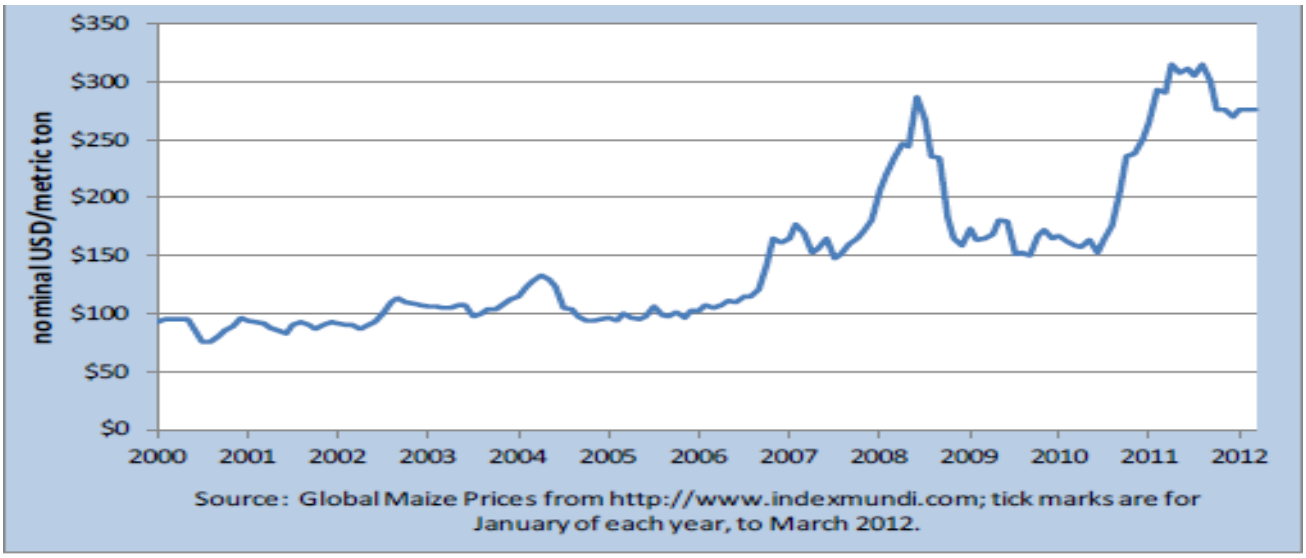
International trade in maize has increased significantly over the past two decades, from 55 million tonnes to around 80 million tonnes. This accounts for only 12 per cent of world maize production. The structure of the world maize market can be charecterised as one with a high level of concentration in terms of exports, but very low concentration on the import side. The main reason for this development is the fact that those countries which usually have significant maize surplus for exports are relatively few in number, while those relying on international markets to meet their needs for domestic animal feeding purpose by importing maize (as a primary feed ingredient) are many. The US is the world's largest maize exporter which account for roughly 60 per cent of the global share, followed by Argentina and China. Brazil, South Africa and Ukraine are among a few other countries which often have surpluses for exports (Abbassian, 2007 and O'Brien, 2010).

According to Grant *et al*. (2012) world maize market conditions affect the South African maize value chain through two specific levers:

- Through its influence on South African exports to the rest of the world (as the demand increases and prices rise, South Africa will export more to international markets), and
- Through its influence on imports to the region (prices that countries need to pay to cover food shortfalls).

[4] Tasseling refers to a development stage in the maize growing cycle when the tassel-like male flowers emerge.

Figure 3.3 provides a brief snapshot of the world market for maize price (based on January each year to March 2012 US FOB prices) over the past twelve years and shows major swinging in the global price. On average figure 3.3 shows that the price of world maize price was increasing from 2000 to 2004. In 2005 the world maize price decreased. This is can be the results of the world maize consumption (demand) being more than world maize production (supply) as shown in figure 3.2. In 2006 the world maize price started to increase. However there has been a maize price spike in 2007/08. This was due to the [5]biofuel production which was responsible for about one quarter of the increase in the world maize price, the remainder attributable mainly to higher oil prices (Abbort and Hurt, 2008). In 2010/11 there has also been a price spike in the world maize price. According to Abbort and Hurt (2011), the two major drivers to the price increase were US biofuels (overwhelmingly maize ethanol) and rising Chinese soybean demand. The world maize price has double since 2006, with major price spikes in 2007 and 2011. This price instability has a major impact on the perceptions of the countries which are heavily dependent on maize for their food security, affecting their internal policy decisions to lead to more protective approaches (Grant *et al*. (2012)



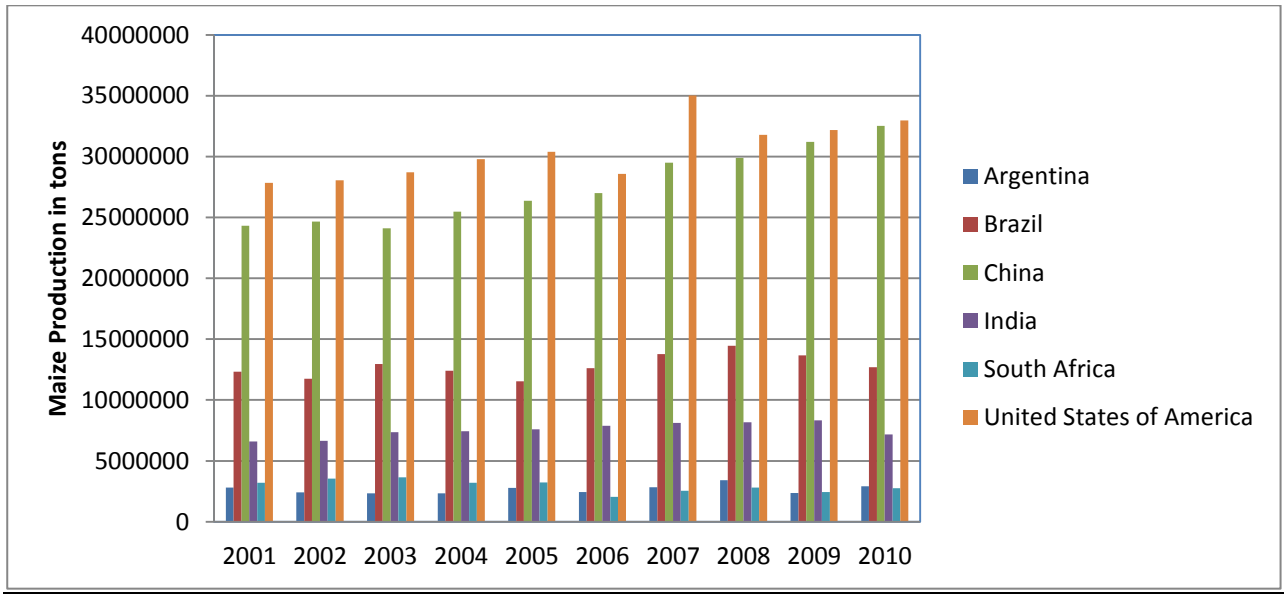
Source : Wise (2012)

Figure 3. 3: Global maize price

[5] More than 40 per cent of US maize is now consumed in the production of ethanol. With the US by far the world's largest producer and exporter of maize, this represents an estimated 15 per cent of global maize production (Wise, 2012)

Globally it is expected that the demand for maize will grow over the next decade and that the composition of the demand will change. Overall, the level of human consumption will decline while the level of animal feed and industrial consumption will increase, especially for biofuel (Grant et al. (2012).

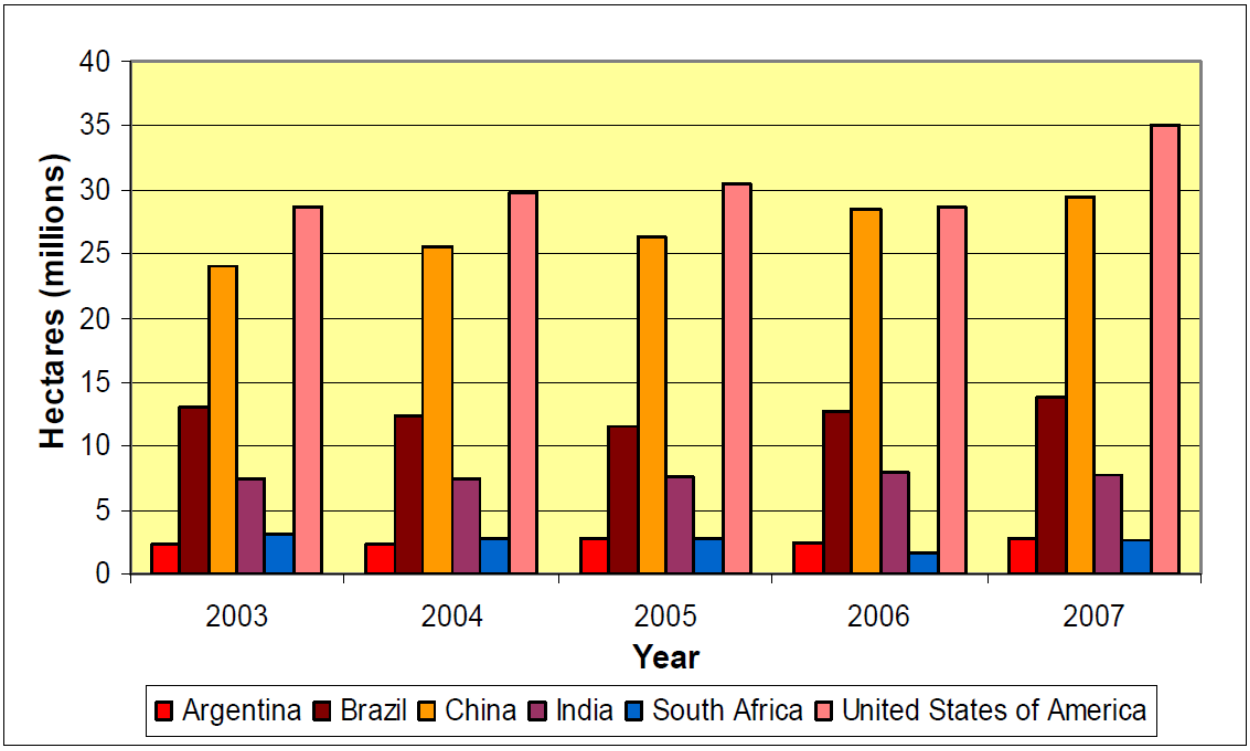
Figure 3.4 shows maize production in South Africa compared with other important maize producing countries in the world from 2003-2007. The dominance of the USA and, to a lesser extent China, is shown, as is the volatility in maize production world-wide.



Source: FAOSTAT (2012)

Figure 3. 4: Maize production in South Africa in a global perspective, 2001 – 2010

Figure 3.5 compares the maize area harvested in South Africa with other countries from 2003 to 2010. In terms of area harvested in the world, United States is also leading. However the difference between what is harvested in China and USA is not significant. In 2010 maize area harvested in China and USA was almost the same. But the production in USA is surpassing China. This indicates that environment for maize production in USA is more efficient than China. When we look at South Africa and Argentina, on average maize area harvested is almost the same. However in terms of production Argentina is more efficient than South Africa. This might be the results of good rainfall that Argentina is normally receiving compare to South Africa.



Source: BFAP (2008), FAO (2009) cited in van Zyl (2010:27)

Figure 3. 5: Comparison of maize area harvested in South Africa with other countries, 2003-2007

3.7 Maize production in South Africa

In South Africa maize is planted between mid October and mid December. Factors such as the rainfall pattern and other weather conditions of a particular season determine the planting period and the length of the growing season (Cass, 2009). Most maize produced in South Africa is cultivated under rainfed conditions. Varieties with a shorter growing period are produced under irrigation (Van Zyl 2010:23). On average South Africa produces 8 to 12 million tons of maize per year (DAFF, 2011).

Table 3.1 illustrates the contribution of each province to maize production in South Africa.

Table 3 1: Contribution of each province to maize production in South Africa

Production year	Free state	Mpumalanga	Gauteng	North west	Western Cape	Eastern cape	Northern cape	KwaZulu-Natal	Limpopo
2000/01	36.0	20.3	4.5	29.6	0.1	0.6	4.3	3.4	1.2
2001/02	33.1	21.2	5.0	29.6	0.1	0.5	5.3	4.1	1.1
2002/03	35.5	20.0	4.5	27.7	0.2	0.5	5.7	4.1	1.7
2003/04	32.7	23.4	5.1	27.1	0.2	0.9	5.4	4.1	1.2
2004/05	35.9	24.5	4.2	25.0	0.2	0.8	4.9	3.5	1.0
2005/06	31.4	24.4	4.9	25.5	0.4	1.1	6.7	4.7	0.9
2006/07	40.1	20.9	3.6	19.5	0.3	1.2	7.6	5.0	1.8
2007/08	38.8	22.6	4.5	22.3	0.3	0.7	5.2	3.9	1.8
2008/09	37.6	23.8	4.4	21.4	0.4	0.8	5.3	4.3	2.0
2009/10	39.6	21.4	5.3	22.4	0.1	0.6	4.8	4.1	1.6
Average	**36.1**	**22.3**	**4.6**	**25.0**	**0.2**	**0.8**	**5.5**	**4.1**	**1.4**

Source: DAFF (2011)

It is evident from Table 3.1 that major producing provinces in South Africa are the Free State, North West and Mpumalanga, followed by Gauteng in some years and the Northern Cape in other years. The three largest maize producing provinces contribute approximately 83 per cent on average towards the total production of maize in the country.

South Africa's marketing year starts in May and ends in April the following year. Maize delivery takes place between May and August. During this time the weather is usually dry and sunny, and the maize is dried in the field before being harvested, with the result that artificial drying is not necessary (SAFEX APD 2002:5). During the delivery period, production is generally more than domestic consumption, leading to an increase in maize stocks. From September to April maize stocks start to decline as consumption exceeds production during this period (Van Zyl 2010:24).

3.8 Maize pricing

The maize price in South Africa used to be fixed annually in a process where the Maize Board recommended a price to the Minister[6]. Under the single channel fixed price, and later single channel

[6] Technically the recommendation was to the Marketing Council, whose main task was to advise the Minister.

pool scheme, the procurement and marketing of maize in the country was relatively simple. There was no competition between suppliers and buyers on the basis of price, as the Board was the buyer from every seller and the seller to every buyer at a fixed price. The domestic market was isolated against the volatility of international prices (SAFEX APD 2002:73). However currently the maize prices is determined by supply and demand and is not isolated against the volatility of international prices and the supply and demand factors which influence the domestic maize price e.g. the size of the United States maize crop and the level of world maize stocks.

In South Africa the maize price is mainly formed on SAFEX. On average 2000 tons of maize is traded on SAFEX daily, which shows that approximately 2% of South Africans total maize production is traded daily (SAFEX 2007). On the Chicago Board of Trade (CBOT) in the US market, some 805 million contracts are traded annually, but this represents only 0.97% of the total US production.

The maize price is influenced by a large number of fundamental factors that affect supply and demand. These include the rand to US dollar exchange rate (since world grain is traded in US dollars) and weather conditions. Consequently the price is very volatile and fluctuates between import and export parity prices (Cass 2009:5).

3.8.1 The determinants of the domestic price of maize

As mentioned earlier the price of maize is normally determined by the world maize price, the exchange rate, stock levels and the relative size of the domestic maize crop. Maize that is located in different countries has different values. For example maize in the US does not have the same value as maize in South Africa; hence the price of maize in different markets must be adjusted to take account of differences in transport costs, exchange rates, etc. in order to make comparisons possible. The adjusted price is called a parity price, which is calculated with respect to a reference point and a specific point in time. In South Africa the reference point for commodities trading on SAFEX (excluding soybeans) is Randfontein (NAMC, 2008).

According to the law of one price, markets are integrated and the difference between two prices at the same point in time equals the transactions costs to move the goods between these markets in the long run (Goodwin *et al*., 1990). The equilibrium price in a small market can be estimated as a function of the equilibrium price in a dominant market, the exchange rate and the transaction costs.

As soon as the difference between these market prices becomes less than the transaction costs, trade is discontinued and the markets are no longer integrated (Sexton, King and Carman, 1991). Now the market equilibrium is a function of the domestic supply and demand factors in each market respectively. Thus, the performance of prices also referred to as the equilibrium pricing condition (Barrett, 1991), in a specific market changes as the market switches between different trade and policy regimes.

In South Africa the prices of commodities trading on SAFEX are adjusted to the parity price by adjusting the international commodity price (Free on board (FoB)[7]Gulf price) by taking into account all the costs incurred in bringing the maize to Durban. This price is called the CIF (Cost Insurance Freight) price, and is adjusted to the local currency using the current exchange rate. Once this is done, all local Rand based costs (including off-loading, interest, insurance, local transport costs and any tariff applicable) can be added, resulting in a final local price per ton at the reference point (NAMC 2008).

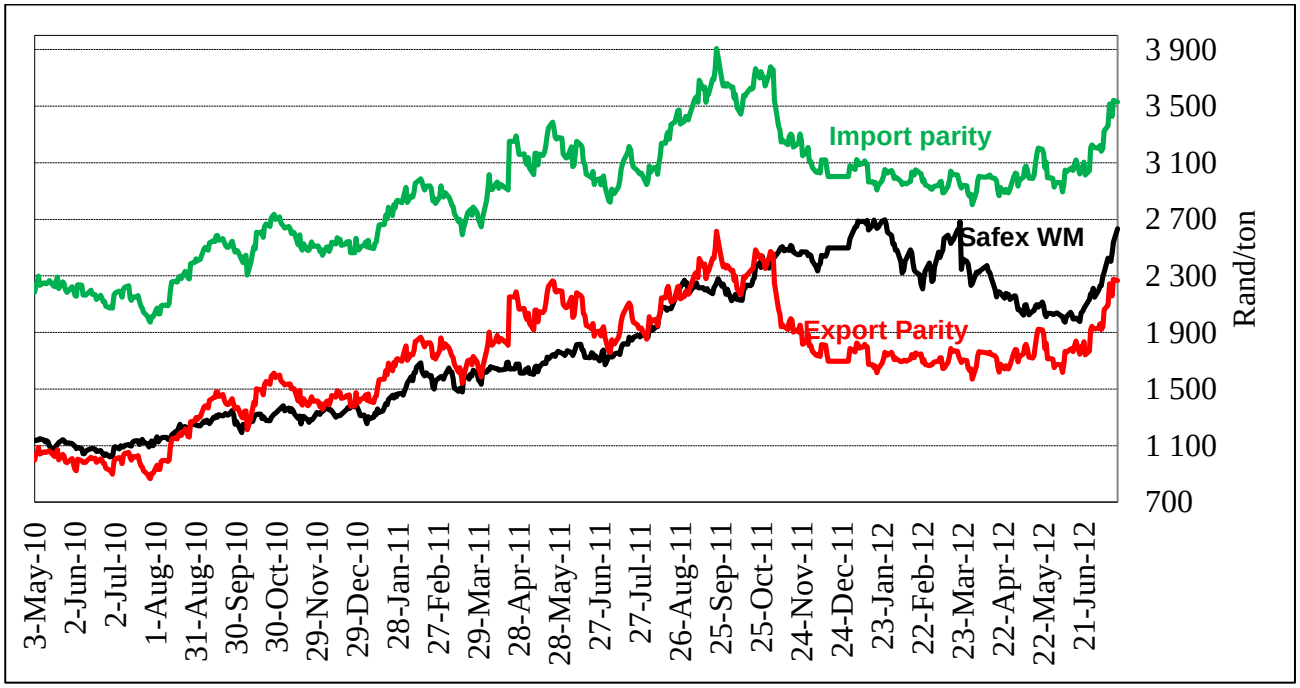
3.8.2 Import and export parity

According to Meyer *et al*. (2006:371) the determination of domestic prices are dictated by a country's specific trade and policy regime, which determines how domestic prices are integrated with world market prices. These regimes include import parity, autarky and export parity.

According to NAMC (2008) the price of maize fluctuates between import and export parity. Import parity is the situation where the maize miller will buy imported maize (including the cost of transport, insurance, the tariff, the exchange rate, etc.) until the price of locally produced maize drops far enough. Millers will import until local maize is priced cheaper than imported maize. In theory import parity is referred to as the ceiling price – if the domestic price increases above this level, millers will rather import. Export parity, on the other hand, is where maize producers will sell their maize to foreign millers until domestic buyers are willing to bid up the domestic price to this level of parity. If the domestic buyers lower their price below this level of parity, exports will resume. Therefore in theory the export parity is referred to as a floor price.

[7] The world price for maize is conventionally quoted as FoB Gulf.

According to Meyer *et al.* (2006: 371) when domestic prices are below import parity but above export parity, domestic prices will be determined by supply and demand conditions in that market. The fluctuation of import and export parity prices for white maize in South Africa is illustrated by Figure 3.5 below.



Source: Grain SA (2012)

Figure 3.6: Import and export parity

From figure 3.5 it is indicated that from May 2010 to August 2010 the export parity was less than the SAFEX price. However from September 2012, the export parity was more than the SAFEX price but less than import parity. This opposes the theory of import and export, where it suggests that the SAFEX price fluctuate between import and export parity. This might be due to surplus of maize that was produced in the country during that period it must also be noted that this period is the harvesting period in the country). It was more profitable for producer to sell their maize to foreign millers as their getting better price. This occurred until October which is the planting season for South Africa. From October 2011 the export parity was less than the SAFEX price.

3.8.3 Maize price versus the exchange rate

The exchange rate also impacts the price of maize. According to Vink and Kirsten (2002) there is correlation between the price of maize and the exchange rate. In their work on the elasticity of the maize price in relation to the current real exchange rate they found that a 1 per cent increase in the exchange rate will lead to 1.16 per cent increase in the price of maize at SAFEX. However they suggested that the maize market is more sensitive to exchange rate depreciation when there is a crop shortage in the region as was the case in the 2001/2002 season.

It is important to note that trade flow and equilibrium pricing conditions under trade regimes in the South African grain markets do not occur strictly according to import parity, Autarky and export parity definitions. In the South Africa white and yellow maize markets, some level of trade does occur with neighbouring countries at price level which suggest that the market is trading under a type of regional autarky isolated from world markets (Meyer *et al*., 2006).

It is argued that trade in the South African region is largely driven by regional issues like staple food, adverse weather conditions, location and quality concerns of genetically modified imported maize from non-African destinations and to a lesser extent by arbitrage opportunities (Meyer *et al*., 2006).

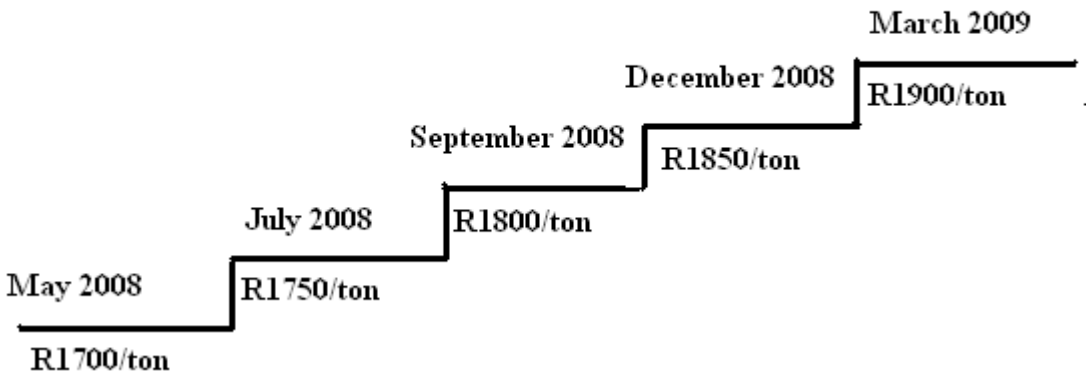
3.8.4 The futures market

According to Groenewald *et al.* (2003:102-3) there are essentially two prices for agricultural commodities. The first one is referred to as the cash price or the spot price. It is the price that the producer will get when he/she sells his/her maize today. But prices also change over time - the price for the same commodity will be different in six months' time. This latter price is referred to as the future price. Seasonal fluctuations occur in the prices of non-perishable agricultural commodities, and it has become practice to conclude contracts for future purchase and delivery of commodities, specifying time, quantity grade and price. The market for these contracts is called a futures market, and it serves to improve the efficiency of the whole system. A contract can be bought and sold: in such a contract a party undertakes to either receive or deliver a specified quantity of a specified quality of a specified product on a specified date and at a specified place at the price at which this contract was concluded.

The development of exchange traded derivative instruments in South Africa started in the late 1980s. An agricultural futures market was established in 1995, since when the volumes of futures and options for white and yellow maize, wheat, soybeans and sunflower seed traded have increased rapidly (Bayley 2000). In South Africa these commodities are all traded on contracts that specify a volume of 100 tons per contract. These contracts specify delivery during March, May, July, September and December (SAFEX, 2007).

3.8.5 Futures Prices

The futures price, or the price at which buyers and sellers are prepared to buy and sell maize futures contracts for a future month reflects a consensus of market opinion. For example it combines the opinion of a producer in the Free State who expects his crop to be smaller because of damage caused by wind and heavy rains, with the opinion of a Mpumalanga producer who expects a bumper crop, with the opinion of a feed manufacture who expects demand for maize to be higher because of herd expansion after good rains and the opinion of a grain trader who experts a good US crop and changes in the statutory maize marketing scheme (SAFEX APD 2002:74). This shows that the futures price is a forecast of what the cash price of maize will be for a given future month based on currently available information. Futures prices will change (move up and down) as the current available information changes. Furthermore, the futures price for each successive month in the production season will usually be higher than the preceding month by the amount of storage and finance charges or carrying charges. This can be represented by Figure 3.6 below (SAFEX APD 2002:74).

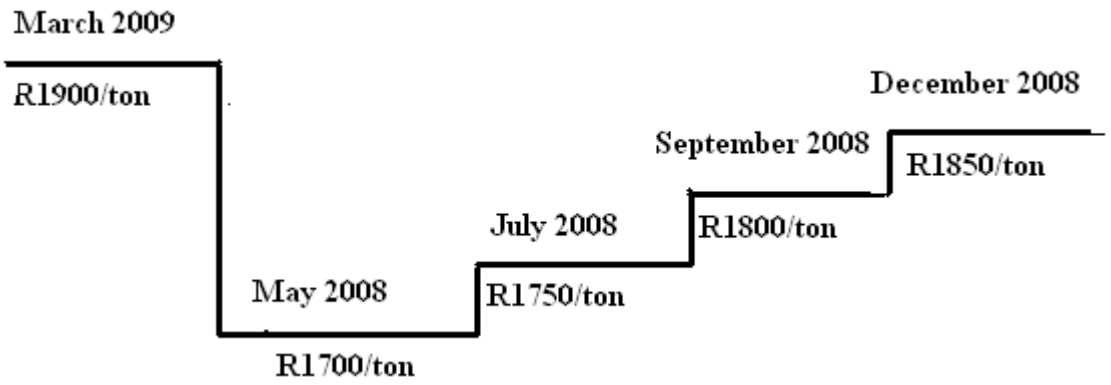


Source: SAFEX APD 2002:74

Figure 3.7: The future price for each succeeding month

According to SAFEX APD (2002:74) futures prices will not always reflect the full carrying charges as sellers are always quick to capitalize on any carrying charge that is greater than the actual cost of storage or transport. Future prices may sometimes reflect negative carrying charges when there is a strong demand for maize and short supply.

The future price of the last month of the maize marketing season (March) may differ sharply from the first two months of the next marketing season (May and July). March reflects old crop maize which may be in short supply, while May and July reflect the new crop as the harvesting period starts during these months, which might depress the price of maize (SAFEX APD 2002:74).



Source: SAFEX APD 2002:74

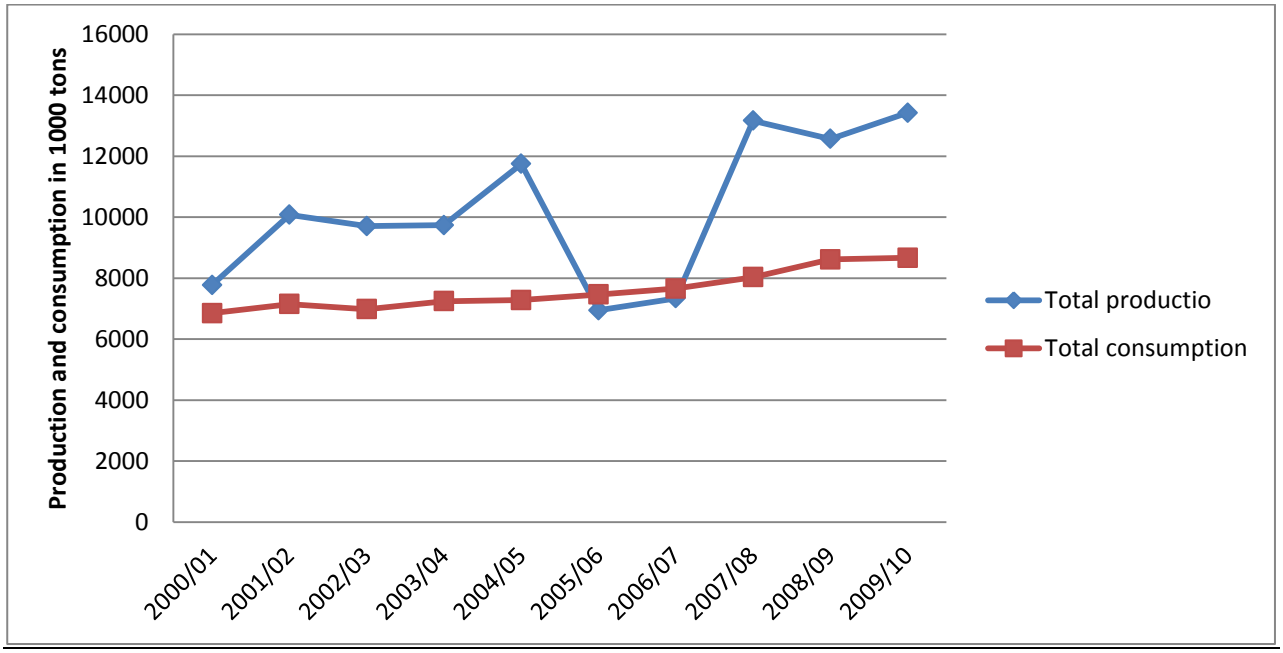
Figure 3.8: Future price for each succeeding month

The future contract allows physical delivery of silo receipts issued by an approved silo owner at any one of the approved silo locations. These silo receipts are deliverable at a discount which reflects the transport cost between the silo location and Randfontein in Gauteng, which therefore serves as the locational reference point for the futures price (SAFEX APD 2002).

3.9 South African production and consumption

According to DAFF (2009) the area planted with maize in South Africa has decreased significantly since the late 1980s. This happened as a result of unfavourable weather conditions (mainly low rainfall) which prompted farmers to either sacrifice maize for drought tolerant crops or reduce their variable costs by reducing the area planted with maize. Figure 3.8 shows South African maize production and consumption from 2000/01 to the 2009/10 maize marketing year. Production has been higher than consumption throughout this period,2006/07 marketing years when the maize producing regions of the country suffered widespread drought. In 2005/06 the consumption has

been higher than production as the results of less area (a 43 per cent decrease compare to area planted maize in 2004/05) planted with maize during that period. This was the results of bumper harvest (11450 million tons) accompanied by large opening stock, which led to a large maize oversupply situation and resulted in depressed maize price. The less area planted was the recommendation by Grain SA follow surplus, which advised maize farmers to plant less maize to avoid maize surplus and bring closer to import parity (NDA, 2007). Both production and consumption have increased over this period – mostly because of the increased production and consumption of yellow maize. Over the decade 2000/01 to 2009/10, the average annual production of maize was some 10.248 million tons compare to consumption of 7.594 million tons. This indicates that there was an average surplus of 2.654 million tons that could be stored or exported.

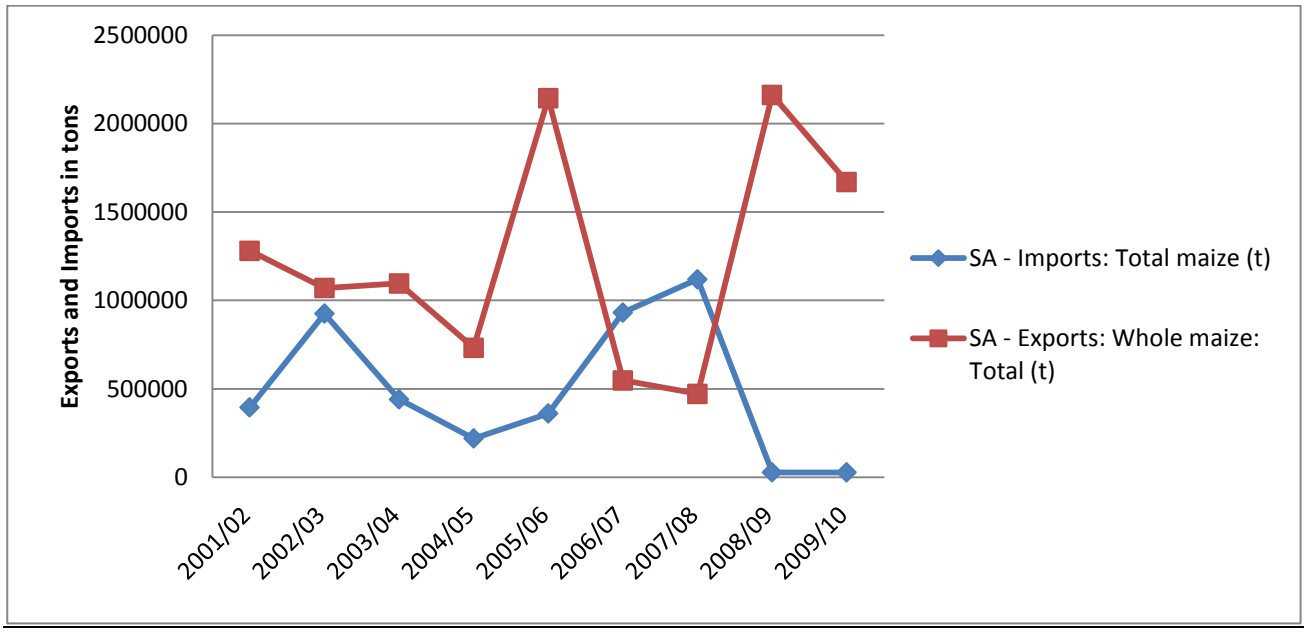


Source: DAFF (2011)

Figure 3.9: South African maize production and consumption

3.10 South African maize imports and exports

Maize is an important earner of foreigner exchange for South Africa, as through export the country can earn foreign currency. Figure 3.9 shows South African maize imports and exports from 2001/02 to 2009/10. Net exports were positive from 2001/02 to 2005/06, and negative through the ensuing two years of drought. However since 2007/08 net exports have been positive again.



Source: DAFF (2011)

Figure 3.10: South African import and export

It is important to look at the leading export market of South African maize. This gives an indication of competition in such market. South Africa did not export maize to the leading world importer of maize. A possible reason for this could be attributed to the closer distance between the leading world importers and other leading exporters of maize, thereby lowering South Africa's competitiveness markets (NAMC and DAFF, 2010).

In 2009 Kenya was the largest importer accounting for 62 per cent of the total value of maize exported by South Africa, with a value of R2.3 billion. Zimbabwe and Zambia were the second and third largest export market of maize from South Africa, with values of R615 million and R193 million respectively. In 2009 Kenya, Zimbabwe, Zambia, Mozambique and Philippines were five largest importers of South African maize represented 90 per cent of the total value of exports (NAMC and DAFF, 2010).

Traditionally South Africa maize farmers have exported surplus to destinations with Africa, mainly to neighbouring countries. A series of bumper maize harvests in Zambia and Malawi, have trimmed South Africa's market share in the region. Another problem has been that some African countries

remain way of genetically modified crops, which account for most of South Africa's maize production (Kumwenda, 2012).

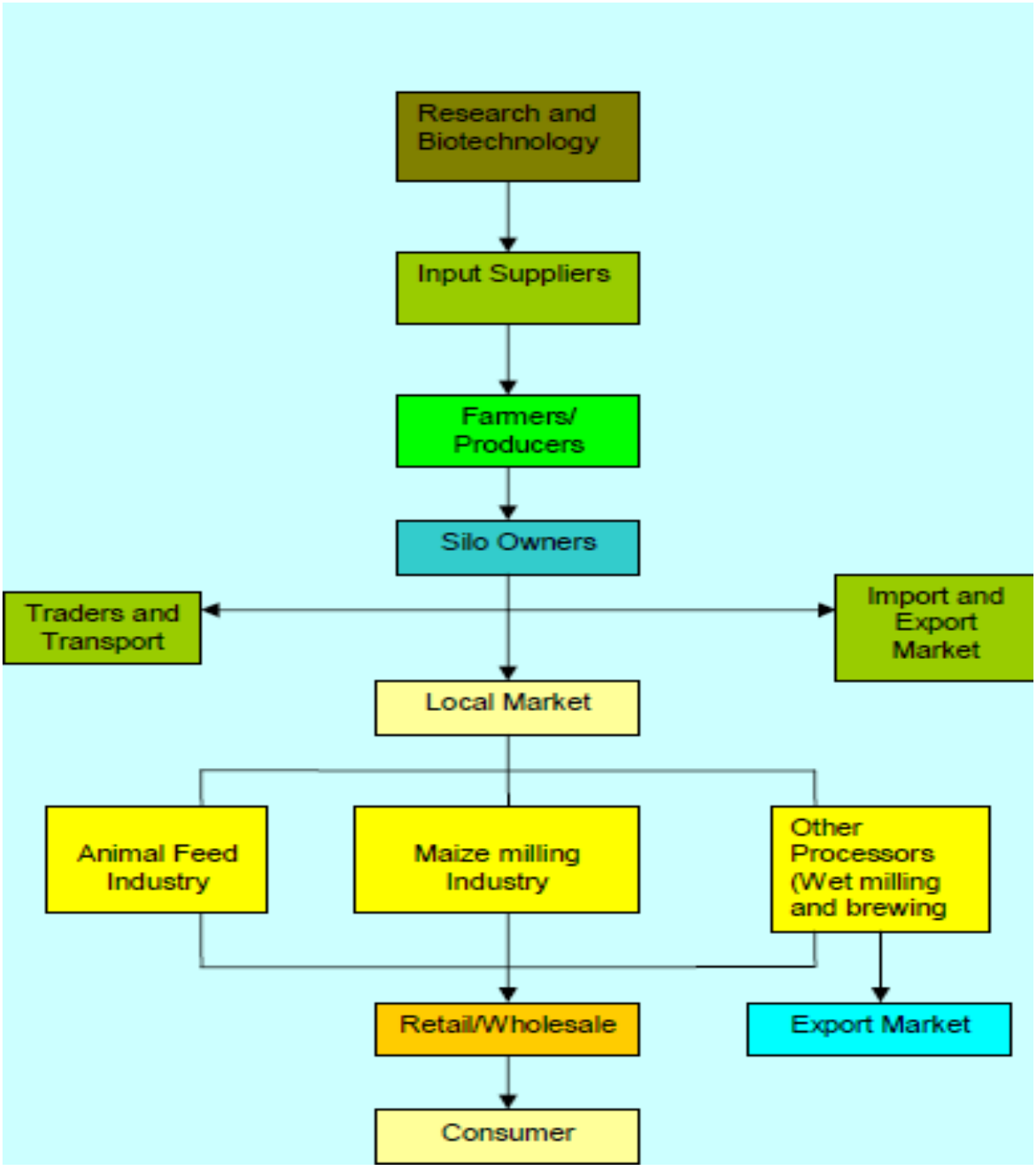
Zambia and Malawi, which have surplus, have export bans in place, only allowing export under special conditions. Therefore, within the region, only South Africa is positioned to meet the needs of the deficit countries. However these two countries have concentrated their surplus maize export to Zimbabwe usually through official marketing channels (Grant *et al*., 2012)

According to USDA (2012), in 2011/12 South Africa exported 2.4 million tonnes (1 700 000 tonnes of white maize and 710 334 tonnes of yellow maize) Mexico accounted for 65 per cent of South Africa's white maize export, with 18 per cent exported to South Korea, and 24 per cent to neighbouring African countries. Taiwan received 23 per cent of the South African yellow maize export, with South Korea accounting for 6.4 per cent and neighbouring African countries 16 per cent.

Asian markets are attractive market for South African maize because of their proximity to South African ports and reduced delivery times compared with the European Union, US and South America (Kumwenda, 2012).

3.11 The maize value chain

In order to understand the maize industry it is important to analyse the value or supply chain. The supply chain of maize consists of different role players which includes inputs suppliers, farmers, silo owners and millers. This section focuses on the different role players (primary, secondary and tertiary sector) in the industry. Analysis of the different role players is based on Figure 3.10 below.



Source: DAFF (2009)

Figure 3.11: Maize value chain

3.11.1 Input suppliers

Inputs suppliers provide inputs to the farmers. These include the maize seed that the maize farmers are using. Currently Monsanto is the largest seed company in South Africa, with a market share of 40 per cent in 2006. Maize farmers are also using fuel, fertiliser and other inputs to produce maize.

In South Africa fertiliser as production input contributes on average between 30 per cent and 50 per cent to a grain producers' variable production cost. This shows it has significant to profitability of grain production in South Africa. In 2008, according to Frost and Sullivan (2008) cited in Grain SA (2011) 86 per cent of the market share in terms of revenue in the fertiliser industry was shared between only three companies i.e. Sasol, Omnia and Yara. However the research is important in the industry in other to develop and improved seed, like drought tolerance seeds (DAFF, 2009 and Grain SA, 2011).

3.11.2 Farmers

In South Africa the agricultural industry is divided into commercial and developing agriculture. According to NAMC (2004) in 2003 the number of commercial maize farmers was estimated at 9000. Production of maize is composed of maize harvested for a particular season, imports and carryover stocks from the previous season. Commercial farmers produce about 98 per cent of maize in South Africa, while the remaining 2% is produced in the communal areas. Commercial maize farmers are estimated to cultivate 3 million hectares of land and employ about [8]150 000 farm workers (DAFF, 2009).

3.11.3 Processing

The primary function of processing is to add value or form utility to maize (Groenewald *et al.* 2003:56). Currently the maize milling industry employs approximately 5 300 workers, while the formal animal feed industry employs an estimated 2 500 employees (DAFF, 2009). After the maize is harvested, the maize kernel is processed by two industries i.e. the wet and dry milling industry. Under the dry milling process the maize kernels are refined to maize meal. This is processed to samp, maize, grits and maize rice, un-sifted, sifted, coarse, super and special maize meal.

In wet milling the maize kernel is processed in water during which pure starch is obtained from the kernels. After the [9]steeping process of 36 hours the kernel can easily be separated into its various

[8] This number includes permanent and temporary farm workers
[9] Steeping process is the process where maize is put in the water to increase the moist content , normally from 14 per cent to 45 per cent

components, namely the husk, starch, gluten and the germ. The germ, gluten, husks and steep water that are obtained from wet milling are used for the production of animal feeds. The animal feed industry is divided into a formal feed industry (members of the Animal Feed Manufacturers Association) and the rest, which includes feedlots, smaller feed millers and home mixers (DAFF, 2009).

The commercial feed industry supplies feed to farmed animals in the country and some are exported to other countries. The feed industry consists of about 100 to 150 feed millers of different sizes. Business forms within the animal feeds industry consists largely of private companies, cooperatives and converted cooperatives. The top animal feed manufactures are Afgri, Bokomo voere, Epol, KK Animal nutrition, Meadow feeds, Noordwes voer and Senwesko voere (DAFF, 2012).

Since deregulation, the number of informal millers has increased sharply from 111 to 296. According to the National Chamber of Milling (cited in DAFF, 2009) there are approximately 22 large scale millers that account for 65 per cent of all maize meal produced in the country. Major players in South African include Pioneer food group (Pty) Ltd, Premier foods Ltd, Pride milling company (Pty)Ltd, Ruto mills (Pty) and Tiger brands Ltd, as well as some silo owners such as NTK. The milling industry was deregulated until 1991, which implies that millers are now free to buy from and sell to their preferred customers (DAFF, 2009).

3.11.4 Handling and storage

Handling and storage play an important role in the maize industry by storing maize for later use. For example in South Africa maize is produced once a year but it is consumed throughout a year. Before deregulation of agricultural markets, farmers were not having their storage. They were selling their maize to the local cooperatives silo because they were not exposed to price risk. After deregulation of the maize industry, 90 per cent of the co-operatives converted to private companies, which own 85 per cent of the total storage capacity, which is currently 16.3 million tonnes. There are 432 silos, of which 172 are on farm and 260 commercial. The commercial silos are owned by 17 silo owners, accounting for 94 per cent of the available silo capacity within the national grain storage market. Most of this storage capacity is located in the province situated in the northern parts of the country (DAFF, 2012). Currently farmer has the following maize storage options after harvest:

- Deliver the maize immediately to a miller

- Make use of the new storage method in the form of silo bags
- Make use of commercial silo off-farm
- Make use of his/her own erected silo

Silo owners store farmers' stocks, grain pools, back to back contracts, and hedge stocks. These grain stocks are discussed in detail below (NAMC, 2008).

- **Farmers' stock:** Under the farmers stock, the maize farmer is the owner of maize. The maize can either be stored on the farm or in a silo. In the case when the farmer delivers his/her maize for storage at a silo, it is not known whether this maize has been sold or not since the sale of the maize takes place by means of a silo certificate. When the maize is delivered to the silo, a silo certificate is issued and the maize farmer can decide when to sell this certificate. The farmer is exposed to the price risk and can hedge against this risk. The silo owner's role is merely to store and handle the maize at a specific cost per month.

- **Grain pools:** In the case of grain pool a group of farmers delivers their maize in a pool. The group of farmers appoints an entity to market their maize and sell their maize stock. A silo owner or a grain trader can be appointed by the group to administer the pool and provide services such as handling and storage. The pool is exposed to price risk and therefore has to be hedged. All price risks and hedging cost are for the account of the specific pool.

- **Back-to-back contracts:** Back to back contracts refer to the situation where the silo owner acts as agent of the buyer of maize (millers/processors) and purchases the maize from the producer. The buyer determines the price and the quality of the grain. The stock belongs to the buyer (e.g. the milling company/processors and not the silo owner). The buyer determines where and when the stock can be utilized. After the maize has been purchased, the silo owner acts as the supplier of storage and handling services.

- **Hedge stock:** With hedge stock the silo owner purchases the maize from the producer. In this case the silo owner becomes the owner who is exposed to price risk. This price risk can be hedged on the futures market. Any role player in SAFEX can now buy stock from the silo owner. When the silo owner has hedged the stock on the futures market, he/she is no longer exposed to price fluctuations and saves on the amount that is normally charged for handling and storage.

3.11.5 Traders

Traders perform a fundamental and core function in a free trade environment by moving the farmer's produce to domestic or export markets. During times of shortage, the traders source goods externally and bring products to the processor or the consumer in the domestic market. Grain traders take positions (forward buying and selling), assume risk, establish value and provide the real cash market for grain. Traders include local grain traders, international grain houses and financial institutions that provide credit facilities. The large traders include Rand Merchant Bank, Senwes, Afgri, Cargill, Louis Dreyfus and Verus Farms (DAFF, 212).

3.12 Chapter summary

This chapter provided some background to the South African maize industry, both in the period before deregulation and after deregulation of agricultural markets. The industry has a long history of government intervention where the maize value chain was heavily regulated by government. The government set the price of maize for farmers and millers and the Maize Board controlled the marketing channel (including exports and imports). Over time, however, the industry has become unregulated.

The deregulation of the market has led to a situation where the price of maize is determined by the forces of supply and demand. The industry is exposed to international market forces, where the price is heavily influenced by major producing countries such as the USA, and by the exchange rate. The chapter also looked at the consumption and production of maize in the world and South Africa. Both production and consumption (South Africa and in the world) of maize are increasing over time.

This chapter also discussed the maize value chain in South Africa. There are many role players in the maize industry, from producer to consumer. Maize is used for animal and human consumption and it is also used as an input for other industries.

CHAPTER 4: RESEARCH METHODOLOGY

4. Introduction

The intention of this study is to identify the factors that affect the hedging decision of the farmers. This statement is based on the assumption that different farmers have different characteristics, which in turn lead to different outcomes. This section is an important part of the study as it will explain how the researcher approached this problem in order to achieve the objectives of the study. This is supported by Leedy and Ormrod (2005:93) who argue that data and methodology are inextricably interdependent, as the methodology for a research problem must always take into account the nature of the data that will be collected in the resolution of the problem.

This Chapter starts with a discussion of the research strategy that is employed, followed by a description of the area where the study conducted. In the third section the data requirement and data sources, methods of data analysis and the properties of the data are analysed.

4.1 Research methods/strategies

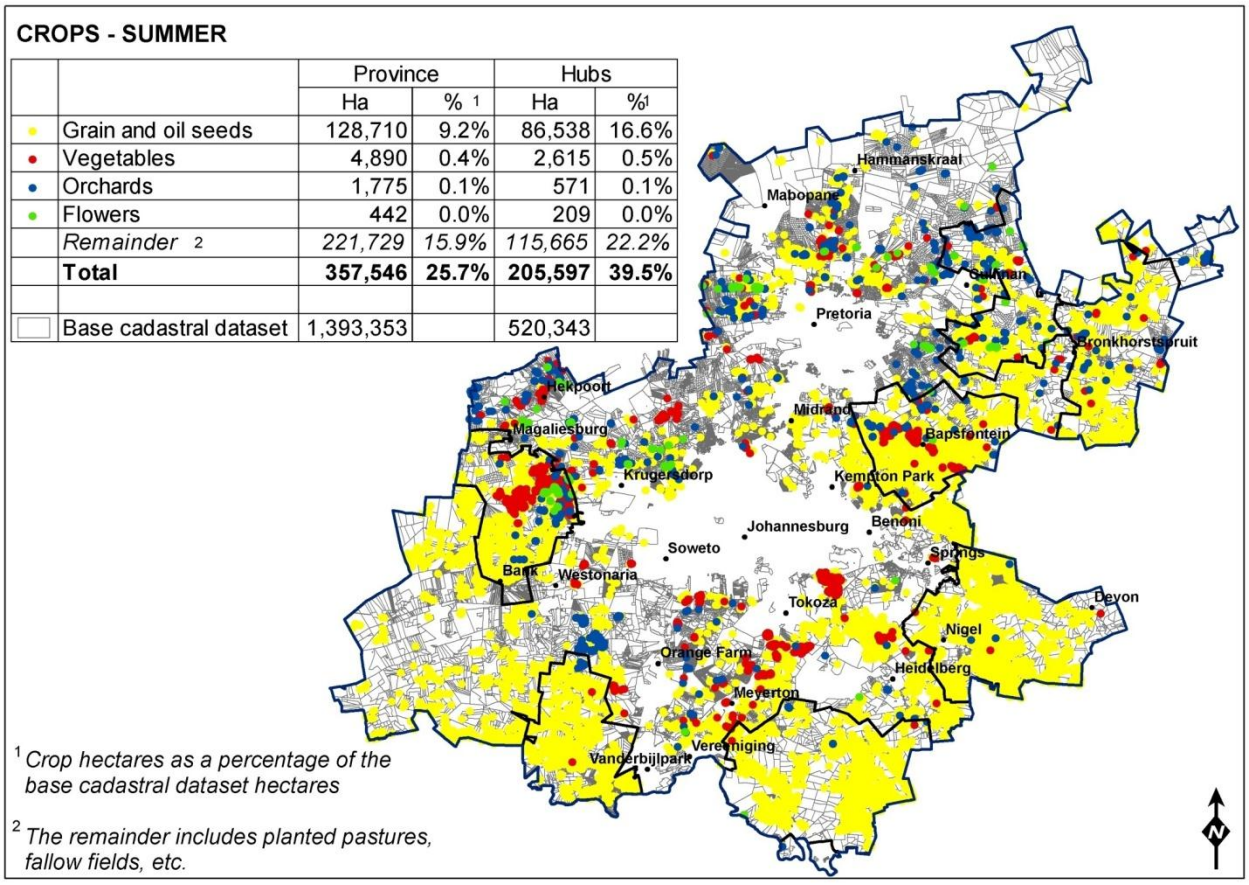
According to Biggan (2008:82) it is important to use appropriate strategies for research. He describes research strategy as the method of describing how you intend implementing your research, i.e. the strategy that you intend adopting to complete your empirical study. This is supported by Musango (2005:25) who explains that research involves the application of a variety of standardised methods and techniques in the pursuit of valid knowledge. Scientists aim to generate truthful knowledge and they are committed to the use of objective methods and procedures that increase the likelihood of attaining validity (Mouton, 1995 cited in Musango, 2005:25).

In this study a number of different methods were used to attain relevant and accurate data that is reliable and valid. According to Leedy and Ormrod (2005) validity and reliability take different forms, depending on the nature of the research problem, the general methodology the researcher uses to address the problem and the nature of the data that is collected. For the purpose of this study the literature has been reviewed to obtain relevant information relating to the maize industry, price risk, hedging/forward contracting and the different characteristics of grain farms and grain farm owner/managers.

4.2 Study area

This study was conducted in Gauteng province. Gauteng covers approximately 17 010 square kilometres, which represents only 1.4 per cent of South African's surface area. It is the smallest province in the country. It enjoys a mild climate characterized by warm, moist summers and cool dry winters. Most rainfall occurs from October to March, with a mean annual precipitation of 668 millimetres (Dent *et al*., 1989).

Gauteng is usually the fourth or fifth largest maize producing province in South Africa, delivering between four and five per cent of the total harvest. It is surrounded by the major maize producing provinces, and is strategically placed as the heartland of the South African economy. Figure 4.1 shows the distribution of agricultural production in Gauteng.



Source: Du Preez (2009)

Figure 4. 1: Distribution of agricultural production in Gauteng province

4.3 Data requirements

Data required in this study will be grouped according to the sub-problems to be resolved. The first sub-problem is to investigate the adoption rate of hedging against price risk by farmers, the second is to identify the farm and farm owner characteristics that affect the hedging decisions of the farmers and the third is to identify the alternative means of reducing price risk. Analysis for these sub-problems will be done based on the responses that will be attained from the questionnaires (a copy of which is provided in Annexure 1) that were sent to farmers in the identified maize growing region. The questionnaire that was sent is designed to obtain relevant information such as how many farmers hedge, farm and farm owner characteristics that affect the hedging decisions of farmers and the alternative means of reducing price risk.

Through the analysis we may be able to say for example maize farmers who are old hedge against price risk, whether the maize farmer who is the principal decision maker in the farm hedges or whether the maize farmers with more years in the grain industry hedge. This will be achieved by the estimation of a probit regression equation for maize producing farms in Gauteng province. The variables included in the probit regression model are described in Table 4.1 below, with the accompanying abbreviation, the way in which it was measured and the expected sign. The source of the data is the questionnaire. It should be noted that the use of a probit regression model or equation was necessitated by the fact that the dependent variable, namely the hedging decision, is binary or dichotomous.

Table 4.1: List of variables used in the Probit regression model

Variable	**Abbreviation**	**Modalities**	**Expected sign**
Hedging decisions (Forward contracting)	HD	Discrete	
Farm and farmers characteristics			
Gender	GENDER	Male=1, otherwise=0	
Race	RACE	Interval variable	
Age	AGE	Interval variable	+/-
Principal occupation	PO	Farming=0, otherwise=1	+
Highest education	HE	Interval variable	+
Agricultural qualification	AGRICQU	Yes=0, otherwise=1	+
Principal decision maker	PDM	Yes=0, otherwise=1	
Member of grain association	MGA	Yes=0, otherwise=1	+

Number of grain association	NGA	Continuous	+
Radio as source of information	RSOI	Yes=0, otherwise=1	+
TV as source of information	TVSOI	Yes=0, otherwise=1	+
Magazine as source of information	MSOI	Yes=0, otherwise=1	+
SMS as source of information	SMSSOI	Yes=0, otherwise=1	+
Internet as source of information	ISOI	Yes=0, otherwise=1	+
Other as source of information	OSOI	Yes=0, otherwise=1	+
Consider rain	CR	Yes=0, otherwise=1	
Period in grain industry	PIGI	Continuous	+/-
Size of the farm	SOFF	Continuous	+/-
Rent land	RL	Yes=0, otherwise=1	
Proportion of the farm rented	POTFR	Interval variable	
Area planted maize 2004	APM 04	Continuous	
Area planted maize 2005	APM 05	Continuous	
Area planted maize 2006	APM 06	Continuous	
Area planted maize 2007	APM 07	Continuous	
Area planted maize 2008	APM 08	Continuous	
Area planted maize 2009	APM 09	Continuous	
Bad experience in Forward contracting	BEIFC	Yes=0, otherwise=1	
Farm debt ratio	FDR	Interval variable	+/-
Marketing skill	MS	Interval variable	+
SAFEX course/workshop attended	SAFEXCA	Yes=0, otherwise=1	+
Determination of spot price	DOSP	Yes=0, otherwise=1	+
SAFEX efficient	SAFEXE	Yes=0, otherwise=1	+
Free market efficient	FME	Yes=0, otherwise=1	+
Free market gives farmers fair deal	FMGFFD	Yes=0, otherwise=1	+
Is SAFEX expensive	ISAFEXE	Yes=0, otherwise=1	-
Off-farm income	OFI	Yes=0, otherwise=1	+/-
Proportion of off-farm income	POFI	Interval variable	_
Insurance	INSUR	Yes=0; otherwise=1	+
Silo/Storage	STR	Yes=0, otherwise=1	_
Use local cooperative	ULCS	Yes=0, otherwise=1	_

4.4 Data sources

The study focuses on maize producers in Gauteng province. In order to get data about maize producers in Gauteng, two main data sources were used namely a structured questionnaire and GrainSA. Each of these data sources is described briefly below.

In the initial round, 28 responses were received. After a number (five) of farmers were contacted individually, a further three responses were received. The number of farmers who were contacted are farmers who are producing maize for commercial purpose and have at least 380[10] hectars of land. In total 31maize farmers faxed and mailed back the complete questionnaires. According to Koutsoyiannis (1977: 83) if the sample is more than 30, this is sufficient for an analysis based on a standard normal distribution.

The primary data for this study was collected through a structured questionnaire survey. According to Musango (2005:26) a questionnaire is a commonly used instrument for obtaining data that is beyond the physical reach of the researcher. It is used because it helps to obtain data that is buried deep within the minds, attitudes, feelings or reactions (Leedy, 1997:191). However a structured questionnaire has both advantages and disadvantages.

On the advantage side, a questionnaire can be sent to a large number of participants who live far away from researcher. Another positive attribute is the ability to allow participants to respond to questions with the assurance that their responses will be anonymous, so they may be more truthful than they would be in a personal interview, particularly when they are talking about sensitive or controversial issues (Leedy and Ormrod, 2005:185).

When it comes to disadvantages, the use of questionnaires often results in low response rates. Leedy and Ormrod (2005:185) note that even when people are willing to participate in a questionnaire, their responses will reflect their reading and writing skills and perhaps their misinterpretation of one or more questions. Therefore these drawbacks need to be taken into account when designing and using questionnaires.

In this study a questionnaire and letter of request for participation were sent to Gauteng maize farmers through the Grain SA office of public relations. The questionnaire was divided into two sections, i.e. section A and section B. Section A covered characteristics of the owner or principal shareholder and farm while section B covered alternative risk management tools. The survey was conducted during 2010.

[10] This is what Jayne *et al*. (2010) recommended as commercial farm for grains

4.5 Data analysis and properties

Although a list of the independent variables is provided in Table 4.1, a list of the transformed variables for analytical purpose is given in table 4.2. In table 4.2. *In* represents natural logarithms and the term *e* is a mathematical constant, the base of the natural logarithm that equals 2.718281828. All continuous variables such as the size of the farm, the number of membership of grain industry associations and the experience of the farmers in the grain industry are transformed into natural logarithms to take care different units used to measure them. For example the size of the farm is measured in hectares while experience in the grain industry is measured in years.

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Table 4. 2: List of the transformed variables used

GENDER	= gender of the farm owner
RACE	= race of the farmer
AGE	= age of the farmer
PO	= principal occupation of the farm owner
HE	= Highest education of the farmer
AGRICQU	= whether the maize farm owner has an agricultural qualification
PDM	= whether the maize farmer is the principal decision maker
MGA	= whether the maize farmer is a member of any grain association
*In*NGA	= number of grain association that the maize farmer has
RSOI	= whether the maize farmer gets grain information through the radio
TVSOI	= whether the maize farmer gets information through television
MSOI	= whether the maize farmer gets information through magazines
SMSSOI	= whether the maize farmer gets information through short message service (SMS)
ISOI	= whether the maize farmer gets information through the internet
OSOI	= whether the maize farmer gets information through any other source of information
CR	= whether the maize farmer considers rain before hedging
*In*PIGI	= the number of years that the maize farmer has been in the grain industry
*In*SOFF	= the size of the farm in hectares
RL	= whether the maize farmer rents in land
POTFR	= the proportion of the total farm size that is rented
*In*APM 04	= the number of hectares that were planted with maize during 2004
*In*APM 05	= the number of hectares that were planted with maize during 2005
*In*APM 06	= the number of hectares that were planted with maize during 2006
*In*APM 07	= the number of hectares that were planted with maize during 2007
*In*APM 08	= the number of hectares that were planted with maize during 2008

*In*APM 09	= the number of hectares that were planted with maize during 2009
BEIFC	= whether the maize farmer has had any bad experiences in forward contracting crops
FDR	= the farm debt ratio of the maize farmer
MS	= how the farmer rates his/her marketing skill
SAFEXCA	= whether the maize farmer has attended a SAFEX course/workshop
DOSP	= whether the maize famers know how the maize spot price is determined on SAFEX
SAFEXE	= whether the maize farmer believes that SAFEX is efficient
FME	= whether the maize farmer believes that the free market is efficient
FMGFFD	= whether the maize farmer believes that the free market gives farmers a fair deal
ISAFEXE	= whether the maize farmer believes that SAFEX is expensive
OFI	= whether the maize farmer has off-farm income
INSUR	= whether the farmer insures his/her crops against natural disaster
POFI	= the proportion of the income of the maize farmer that is derived from non-farm activities
STR	= whether the maize farmer has silo/storage to store his/her maize after harvesting
ULCS	= whether the maize farmer uses the local cooperative silo to store his/her crops after harvest

The underlying assumption for the dependent variable is that the maize producer will make decisions that improve his or her welfare. The dependent variable is 0 when the maize farmer has ever forward contracted maize again price risk and 1 when a maize producer has never forward contracted maize. The hedging decision was the dependent variable in the probit regression model.

4.6 Specification of the econometric model

This study applies an econometric model to determine the specific characteristics that influence the hedging decisions of maize farmers in Gauteng. Models provide a systematic and comprehensive approach to analyse and forecast behaviour (Meyer, 2002: 30). According to Tomek (1993), cited in Meyer (2002: 31) the strength of agricultural economics rests in its capacity to combine theory, quantitative methods and data to conduct useful analysis of problems faced by society. Gujarati (2003:517) mentioned that in practice researchers are never sure that the model adopted for empirical testing is the correct one.

The Probit regression equation was formulated as follows:

$$HD = \beta o + \beta_1 D_1 GENDER + \beta_2 D_2 RACE + \beta_3 D_3 RACE + \beta_4 D_4 RACE + \beta_5 D_5 RACE + \beta_6 D_6 AGE + \beta_7 D_7 AGE + \beta_8 D_8 AGE + \beta_9 D_9 AGE + \beta_{10} D_{10} AGE + \beta_{11} D_{11} PO + \beta_{12} D_{12} HE + \beta_{13} D_{13} HE + \beta_{14} D_{14} HE + \beta_{15} D_{15} HE + \beta_{16} D_{16} AGRICQU + \beta_{17} D_{17} PDM + \beta_{18} D_{18} MGA + \beta_{19} InNGA + \beta_{20} D_{20} RSOI + \beta_{21} D_{21} TVSOI + \beta_{22} D_{22} MSOI + \beta_{23} D_{23} SMSSOI + \beta_{24} D_{24} ISOI + \beta_{25} D_{25} OSOI +$$

$\beta_{26}D_{26}$CR + β_{27}InPIGI + β_{28}InSOFF + $\beta_{29}D_{29}$ RL + $\beta_{30}D_{30}$POTFR + $\beta_{31}D_{31}$POTFR + $\beta_{32}D_{32}$POTFR + $\beta_{33}D_{33}$POTFR + $\beta_{34}D_{34}$POTFR + β_{35}InAPM 04 + β_{36}InAPM 05 + β_{37}InAPM 06 + β_{38}InAPM 07 + β_{39}InAPM 08 + β_{40}InAPM 09 + $\beta_{41}D_{41}$BEIFC + $\beta_{42}D_{42}$FDR + $\beta_{43}D_{43}$FDR + $\beta_{44}D_{44}$FDR + $\beta_{45}D_{45}$FDR + $\beta_{46}D_{46}$MS + $\beta_{47}D_{47}$MS + $\beta_{48}D_{48}$MS + $\beta_{49}D_{49}$MS + $\beta_{50}D_{50}$MS + $\beta_{51}D_{51}$SAFEXCA + $\beta_{52}D_{52}$DOSP + $\beta_{53}D_{53}$SAFEXE + $\beta_{54}D_{54}$FME + $\beta_{55}D_{55}$FMGFFD + $\beta_{56}D_{56}$ISAFEXE + $\beta_{57}D_{57}$OFI + $\beta_{58}D_{58}$POFI + $\beta_{59}D_{59}$POFI + $\beta_{60}D_{60}$POFI + $\beta_{61}D_{61}$POFI +$\beta_{62}D_{62}$INSUR + $\beta_{63}D_{63}$STR + $\beta_{64}D_{64}$ULCS + e_1

Where:

Table 4. 3: Explanation of the probit regression equation variables

D_1GENDER	= 0 if farm owner is male; = 1 otherwise
D_2RACE	= 0 if farm owner is white; = 1 otherwise
D_3RACE	= 0 if farm owner is African; = 1 otherwise
D_4RACE	= 0 if farm owner is colored; = 1 otherwise
D_5RACE	= 0 if farm owner is Indian; = 1 otherwise
D_6AGE	= 0 if farm owner is less than 30; = 1 otherwise
D_7AGE	= 0 if farm owner is at 30 – 39 of age; = 1 otherwise
D_8AGE	= 0 if farm owner is at 40 – 49 of age; = 1 otherwise
D_9AGE	= 0 if farm owner is at 50 – 60 of age; = 1 otherwise
D_{10}AGE	= 0 if farm owner is more than 60 years of age; = 1 otherwise
D_{11}PO	= 0 if the farming principal occupation; = 1 otherwise
D_{12}HE	= 0 if the famer has Grade 12 or lower; = 1 otherwise
D_{13}HE	= 0 if the farmer has Technicon/college diploma or degree; = 1 otherwise
D_{14}HE	= 0 if the farmer has University degree; = 1 otherwise
D_{15}HE	= 0 if the farmer has postgraduate degree; = 1 otherwise
D_{16}AGRICQU	= 0 if the farmer has agricultural qualification; = 1 otherwise
D_{17}PDM	= 0 if the farmer is the principal decision maker; = 1 otherwise
D_{18}MGA	= 0 if the farmer is member of grain association; = 1 otherwise
*In*NGA	= number of grain association that the maize farmer have
D_{20}RSOI	= 0 if the farmer get grain information through radio; = 1 otherwise
D_{21}TVSOI	= 0 if the farmer get grain information through television; = 1 otherwise
D_{22}MSOI	= 0 if the farmer get grain information through magazine; = 1 otherwise
D_{23}SMSSOI	= 0 if the farmer get grain information through SMS; = 1 otherwise
D_{24}ISOI	= 0 if the farmer get grain information through internet; = 1 otherwise
D_{25}OSOI	= 0 if the farmer get grain information through other sources; = 1 otherwise
D_{26}CR	= 0 if the farmer consider rain before hedging; = 1 otherwise
*In*PIGI	= the number of year that the maize farmer has been in the grain industry

*In*SOFF	= the size of the farm in hectares
D_{29}RL	= 0 if the farmer rent land; = 1 otherwise
D_{30}POTFR	= 0 if the farmer does not rent land; = 1 otherwise
D_{31}POTFR	= 0 if the farmer rent less 25 % of land; = 1 otherwise
D_{32}POTFR	= 0 if the farmer rent 25 – 49 % of land; = 1 otherwise
D_{33}POTFR	= 0 if the farmer rent 50 – 74 % of land; = 1 otherwise
D_{34}POTFR	= 0 if the farmer rent 75 – 100 % of land; = 1 otherwise
*In*APM 04	= the number of hectares that were planted with maize during 2004
*In*APM 05	= the number of hectares that were planted with maize during 2005
*In*APM 06	= the number of hectares that were planted with maize during 2006
*In*APM 07	= the number of hectares that were planted with maize during 2007
*In*APM 08	= the number of hectares that were planted with maize during 2008
*In*APM 09	= the number of hectares that were planted with maize during 2009
D_{41}BEIFC	= 0 if the farmer had experience in forward contracting; = 1 otherwise
D_{42}FDR	= 0 if the farmer has the farm debt ratio of 25%; = 1 otherwise
D_{43}FDR	= 0 if the famer has farm debt ratio of 25 – 49 %; = 1 otherwise
D_{44}FDR	= 0 if the farmer has farm debt ratio of 50 – 74 %; = 1 otherwise
D_{45}FDR	= 0 if the farmer has farm debt ratio of more than 75%; = 1 otherwise
D_{46}MS	= 0 if the farmer has very poor marketing skill; = 1 otherwise
D_{47}MS	= 0 if the farmer has poor marketing skill; = 1 otherwise
D_{48}MS	= 0 if the farmer has average marketing skill; = 1 otherwise
D_{49}MS	= 0 if the famer has good marketing skill; = 1 otherwise
D_{50}MS	= 0 if the famer has very good marketing skill; = 1 otherwise
D_{51}SAFEXCA	= 0 if the farmer has attended SAFEX course/workshop; = 1 otherwise
D_{52}DOSP	= 0 if the famer knows how the spot price is determined at SAFEX; = 1 otherwise
SD_{53}AFEXE	= 0 if the famer believes that SAFEX is efficient; = 1 otherwise
D_{54}FME	= 0 if the farmer believes free market is efficient; = 1 otherwise
D_{55}FMGFFD	= 0 if the farmer believes free market gives farmers fair deal; = 1 otherwise
D_{56}ISAFEXE	= 0 if the farmer believes SAFEX is expensive; = 1 otherwise
D_{57}OFI	= 0 if the farmer has off-farm income; = 1 otherwise
D_{58}POFI	= 0 if the proportion of the income that is derived from nonfarm activities is less than 25%; = 1 otherwise
D_{59}POFI	= 0 if the proportion of the income that is derived from nonfarm activities is 25 – 49%; = 1 otherwise
D_{60}POFI	= 0 if the proportion of the income that is derived from nonfarm activities is 50 – 75; = 1 otherwise
D_{61}POFI	= 0 if the proportion of the income that is derived from nonfarm activities greater than 75%; otherwise
D_{62}INSUR	= 0 if the farmer has insurance for crops; = 1 otherwise

D_{63}STR	= 0 if the farmer has his/her own storage; = 1 otherwise
D_{64}ULCS	= 0 if the farmer use local cooperative silo; = 1 otherwise

In the formulated equation above, βs represent the estimated parameters and the Ds are dummy variables. *In* represents natural logarithms as explain in section 4.5. This table 4.3 is different from other tables (Table 4.1 and 4.2) because it explains probit regression equation variable in details.

4.7 The Probit regression model

This paper will deal with the problem of estimating an equation on the basis of data in which the dependent variable is dichotomous. A Probit regression model is used to evaluate the impact of maize farm and owners' characteristics on the hedging decision of the maize farmers in Gauteng. A Probit regression model is used because the dependent variable (hedging decision) is a binary variable. In the theoretical framework the assumption was made that the maize farmer could hedge or not hedge. It must also be noted that hedging includes cash forward contracting, forward pricing and hedging with futures and options through SAFEX, and that no distinction was made between direct and indirect (cash forward, forward pricing, futures and options) means of hedging.

According to Gujarati (2003:582) there are three approaches to develop a probability model for a binary response variable i.e. the Linear Probability Model (LPM), the logit model and the probit model. The LPM is plagued by several problems, such as non-normality of μ, heteroscedasticity of μ, possibility of the estimated dependent variable lying outside the 0 – 1 range and the generally lower R^2 values (Gujarati, 2003: 593). When it comes to probit and logit the results that are obtained are almost the same. However the researcher believes that it is easier to estimate a probit model with the available statistical software (SPSS 20).

Gujarati (2003:608) argues that the probit model can be presented based on utility, or a rational choice perspective on behaviour as developed by McFadden (1973). Amemiya (1981); Greene (1993) and Verbeek (2000) show that discrete models which are strongly linked to utility theory have been widely used in economics to investigate factors affecting an individual's choice from two or more alternatives. Goodwin and Schroeder (1994); Mishra and Perry (1999); and Katchova and Miranda (2004) have modelled the decision making process in agriculture as a utility maximization problem for producers.

Theoretically, a producer will always prefer to participate in hedging if it maximizes profit (Bekele, 2004). Mishra and Perry (1999) represented the producer profit function as follows:

$\pi_{i=f\lambda q_1 + r(1-\lambda)q_1 -}[\text{[illegible]}_i + \alpha q_i + \rho\lambda q_1 + \delta_i]$..... (1)

where f represents the price received with hedging, r is the spot price, q is the output of the grain crop, $\lambda(1-\lambda)(0 \leq \lambda \leq 1)$ is the proportion of the maize crop sold in the forward contract, Υ is the total fixed production cost, αq_i is the variable cost component and δ and ρq are the fixed cost and variable costs associated with the forward contract and spot transaction. The key difference between spot market use and forward contracting is that the spot market entails higher transaction costs to the producer due to information gathering, service quality and price discovery (Brusset, 2005).

Mishra and Perry (1999) argue that profit is stochastic, since output as prices are random variables. As such, a Taylor's series expansion of equation 1, under assumption that the producers are risk averse (∂_1), implied an expected utility of profit function with observable variables in terms of its mean (μ) and variance (σ^2)

EU $(\pi_i) = f_i(\mu, \sigma^2, \partial_1)$..... (2)

Farmers' behaviour is not only driven by the maximization of profit, rather it is the result of a complex process that is affected by farm and owner characteristics and alternative risk management tools (Willock *et al.*, 1999). In light of this, upon maximizing the expected utility profit (equation 2), Mishra and Perry (1999) found an expression relating to the producers' preference to hedge. The expression can be related to a set of observable producers and characteristics (X), the coefficient vector (β) and the residual error (ε).

$\lambda = g(\beta_i X_i) + \varepsilon_i$.....(3)

Notably, McFadden (1973) acknowledges that the residual error term represents heterogeneity across a producer's preference, once the observable variables have been taken into account. Since λ is unobservable, the author applied a discrete choice model with λ = 1 otherwise, meaning the author assumed a dichotomous dependent variable.

Verbeek (2000) and Bekele (2004) mentioned that with appropriate distributional assumptions on the error terms, the approach leads to a manageable expression for probabilities implied by the model. Under this model specification, a standard distribution of the error terms is assumed and it has a mean of μ = 0 and a variance of $\sigma^2 = \pi^2/3$ and is symmetric around its zero mean. To overcome the concern of endogeneity bias, this application further assumes that there is no correlation between the error terms.

This particular model applies a probit regression model where the farmers' decision is assumed to be of a dichotomous nature. This discrete dependent variable is defined as the maize farmer preference to hedge against uncertainties, conditional on owner and farm characteristic and alternative risk management tools.

$$\lambda_n = \begin{cases} o, hedge\ against\ uncertainties\ in\ maize \\ 1, prefer\ spot\ market\ for\ maize\ , otherwise \end{cases} \quad \text{.....(4)}$$

The equation above shows that each producer indicates a preference between two alternatives. A stochastic utility is associated with each alternative and the maize farmers choose the one with the utility is the highest. The distribution of the random variables, which describe the valuations of alternatives, expresses the distribution of the producer preferences.

4.8 Chapter summary

This chapter described the methodology used to collect and analyse the data. The research strategy, study area, data sources and data requirements were also outlined and described. The variables that are used in the study were explained. The different data analysis techniques and data properties were looked at in detail. A probit regression model was discussed in detail and the reason why this model was chosen has been highlighted. Also the economic model and equation was specified. Overall, this chapter discussed all processes of obtaining and analysing all relevant data. The next chapter presents the analysis and results of the data collected.

CHAPTER 5: RESULTS AND ANALYSIS

5.1 Introduction

The purpose of this study is to identify factors affecting the hedging decision of maize farmers. In order to achieve this goal, a number of sources were used for the analysis. The data relates to maize farmers in Gauteng province. The contact details of the farmers were sourced through the assistance of Grain SA. A questionnaire was designed to collect data on the characteristics of maize farms and maize farm owners. The results reported in this research focus on a number of aspects. The data were analysed using Excel and SPSS 20 to identify the factors that most affected the hedging decision of the farmers.

5.2 The characteristics of maize farms and farm owners

It is noteworthy to report and examine maize farm and owner characteristics at this stage because further analysis will greatly depend on the statistics presented in this regard. The first step is to present the results from the survey data by showing the averages for continuous variables employed in this study as shown in table 5.1.

Table 5.1: Mean value of continuous variables

Variable	Mean	Standard Deviation
Number of business associations	3.0323	1.68293
Experience in grain industry	17.1935	8.46333
Size of the farm	993.6129	910.03405
Area planted maize in 2004	598.4839	385.28248
Area planted maize in 2005	588.3548	342.85649
Area planted maize in 2006	594.1613	312.9294
Area planted maize in 2007	612.3226	346.77114
Area planted maize in 2008	596.6452	366.29501
Area planted maize in 2009	621.7097	313.17824

The results in Table 5.1 indicate that farmers on average belong to 3 business associations, which is an indication of extensive networking groups. Furthermore, farmers have on average 17 years of farming experience in the grain industry, which means that most of them were farming in the period before deregulation.

The average size of the maize farm in this study is 994 ha. However, these farmers do not only plant maize, and the area planted to maize fluctuates from year to year, albeit within a relatively narrow band of around 10 per cent.

The results with regard to the farm debt ratio are presented in Figure 5.1, which shows that some 38.7 per cent of the maize farmers have a farm debt ratio of less than 25 per cent, while close to half (48.4 %) of maize farms have a farm debt ratio of between 25 and 49 per cent and 12.9 per cent a farm debt ratio of 50 to 74 per cent. This is an indication that most farms are conservatively managed.

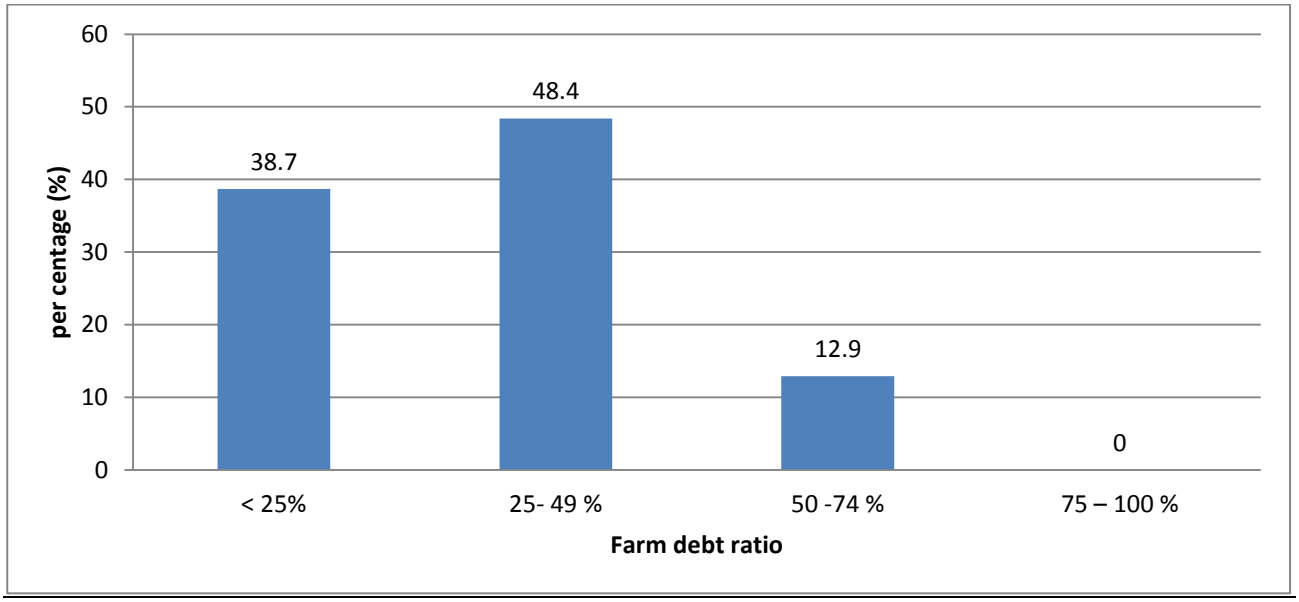

Figure 5.1: Farm debt ratio

Furthermore, Table 5.2 shows that a full 71 per cent of these maize farmers rent land, again a sign of conservative financial management. The proportions of rented land are presented in Figure 5.2. This indicates that 22.6 per cent of the respondents rent less than 25 per cent of the land that they operate, and more than 90 per cent rent less than half of their land. Only 6.5 per cent of respondents rent between 50 and 75 per cent of land and 3.2 per cent rent more than 75 per cent of their land.

Table 5.2: Rented land

Characteristics		Frequency	Percentage
Rent land	Yes	22	71.0
	No	9	29.0
Total		31	100.0

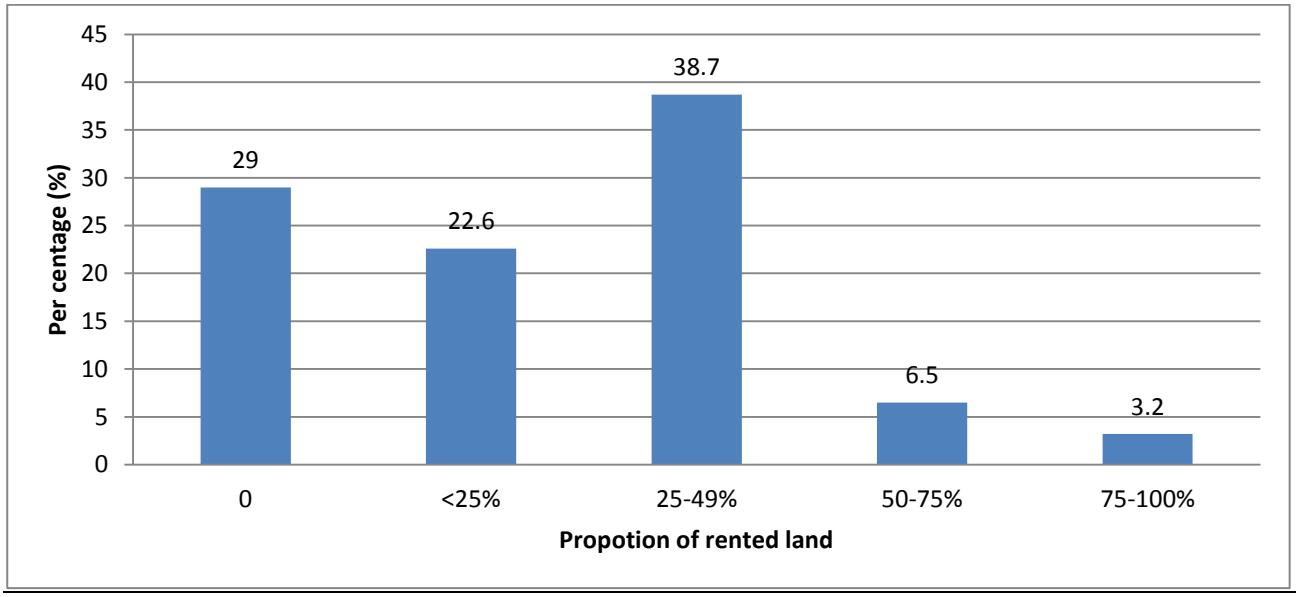

Figure 5.2: Proportion of rented land

The results for the general farmer characteristics are presented in Table 5.3. The results indicate that the majority (96.8 per cent) of the farm owners are males, and some 83.9 per cent of the respondents are still dependent on farming as their principal occupation. Just over half (54.8 per cent) of maize farmers indicate that they have some sort of agricultural qualification, including a certificate, a diploma and/or a University degree. Over three quarters (83.9 per cent) of the farmers indicated that they are the principal decision makers on their maize farms. It is evident that all the farmers, with only one exception, are members of a business association.

Table 5.3: Farmer characteristics

Characteristics		Frequency	Per cent
Gender	Male	30	96.77
	Female	1	3.23
Principal occupation	Farming	26	83.87
	Other	5	16.13
Agricultural qualification	Yes	17	54.84
	No	14	45.16
Owner principal decision maker	Yes	26	83.87
	No	5	16.13
Member of business association	Yes	30	96.77
	No	1	3.23

From Table 5.4 it is evident that only 35 per cent of the maize farm owners forward contracted their maize against price risk, although only 39 per cent of them have had a bad experience in forward contracting their maize and over three quarters of maize farmers had attended a course dealing with SAFEX. Most (90 per cent) of the maize farmers indicated that they understand how the spot price is determined at SAFEX. On the other hand, 55 per cent thought that dealing on SAFEX was expensive, while fully 94 per cent did not think the free market gave farmers a fair deal even though 55 per cent thought the free market was efficient and 61 per cent thought that SAFEX was efficient.

Table 5.4: Owners marketing characteristics

Characteristics		Frequency	Per cent
Forward contracted	Yes	11	35
	No	20	65
Bad experience	Yes	12	39
	No	19	61
SAFEX course attended	Yes	26	84
	No	5	16
Determination of spot price	Yes	28	90
	No	3	10
SAFEX efficient	Yes	19	61
	No	12	39
Free market efficient	Yes	17	55
	No	14	45
Free market fair deal	Yes	2	6
	No	29	94

SAFEX expensive	Yes	17	55
	No	14	45

As was shown earlier, most maize farmers in Gauteng have been in the grain industry for some time. Figure 5.3 shows that fully 45 per cent of the farmers have been in the industry for more than 20 years, and almost 80 per cent for more than 10 years. There is little doubt that this explains their conservative financial management, and their unwillingness to make use of the hedging opportunities on SAFEX.

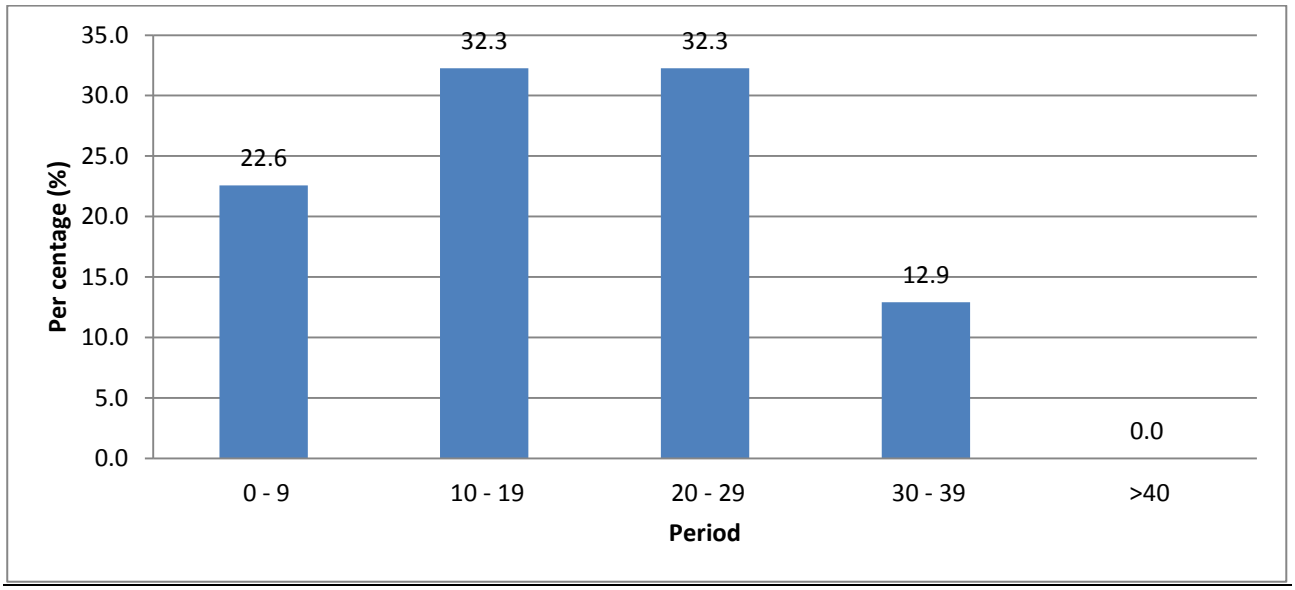

Figure 5.3: Period in the grain industry

The data shown in Figure 5.4 provides further evidence: most farmers in the sample (58 per cent) are older than 50, while a further 22.6 per cent are between 40 and 50 years old. Fewer than 20 per cent are younger than 40.

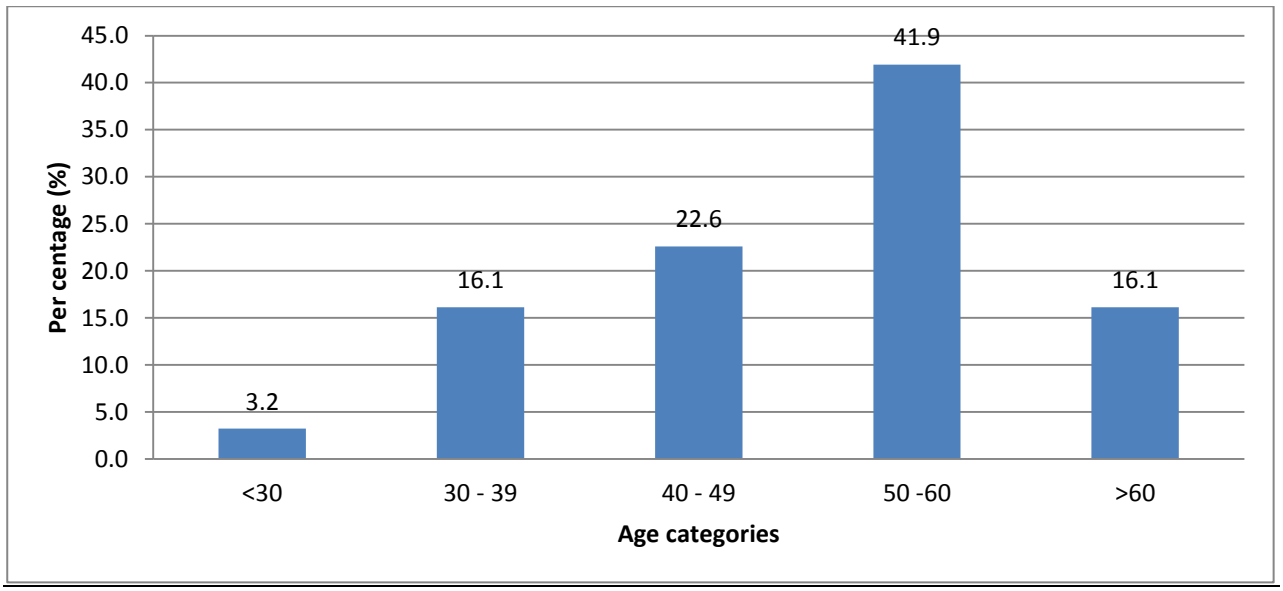

Figure 5.4: Age of the farmers

It is well known that individuals who have more knowledge have a competitive advantage over their counterparts. There are many sources of information that the maize famers can use to get information about the maize industry and factors affecting the industry such as the weather. In this study radio, television, magazines, SMS, internet and others were identified as potentially important sources of information for maize farmers.

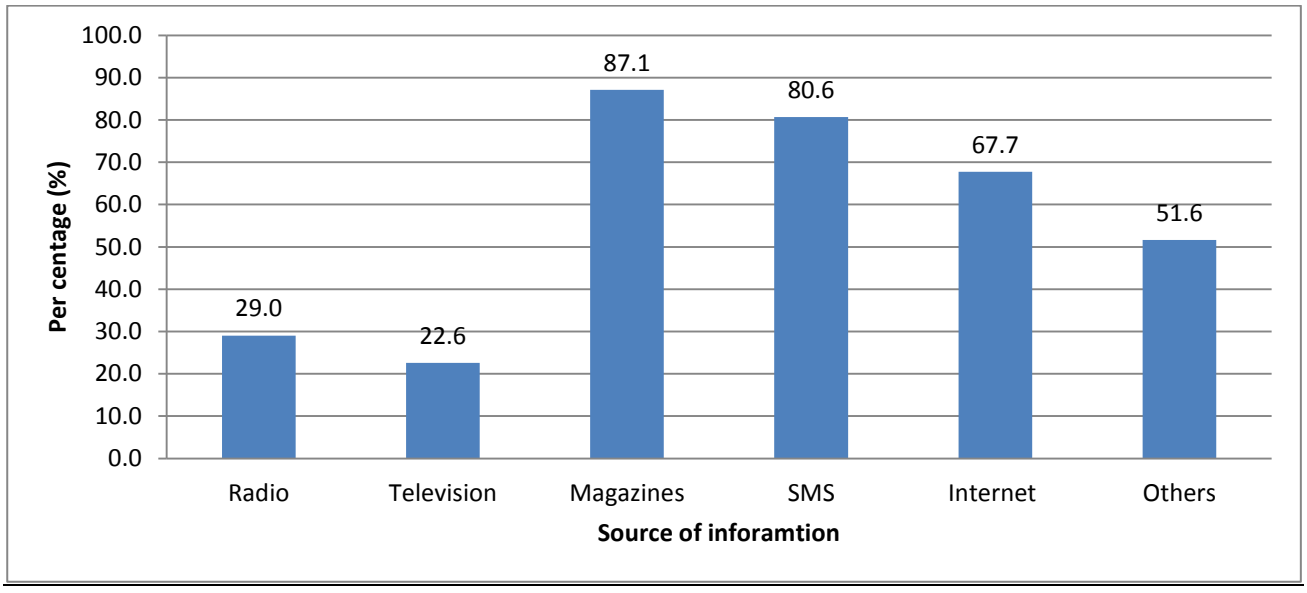

Figure 5.5: Source of maize information

Figure 5.5 indicates that the majority (87.1%) of the maize farmers get information through magazines. The second most prevalent source of maize information is indicated as SMS, which is used by 80.6 per cent of the maize farmers. The Internet is the third biggest source, while the traditional media (radio and television) are used by fewer than 30 per cent of the farmers. The use of SMS and internet indicates that majority of the maize farmers are adopting the use of information technology to do business.

5.3 Alternative risk management tools

This section looks at the alternative risk management tools that the farmers can use to minimize risk in their business. Table 5.5 indicates that most of the maize farmers (58 per cent) do not have off-farm income i.e. most derive their income primarily from farming activities. When it comes to insurance of maize against natural events that can be identified and quantified, most (87 per cent) insure their crops against natural events.

Table 5.5 also shows that more than three quarters of the maize farmers do not have their own storage facilities, while only 22.6 per cent have the capacity to store their own maize after harvesting. Most farmers use the storage facilities at their local cooperative.

Table 5.5: Alternative risk management tools

Characteristic		**Frequency**	**Per cent**
Off farm income	Yes	13	42
	No	18	58
Insurance	Yes	27	87
	No	4	13
Own silo/storage	Yes	7	22.6
	No	24	77.4
Use local cooperative silo	Yes	19	61.3
	No	12	38.7

5.4 Hedging versus farm and owner characteristics

As already indicated in Chapter 4, different characteristics determine the hedging decision of farmers. Also as indicated earlier, 35 per cent of the maize farmers reported that they hedged their

maize against price risk, while 65 per cent indicated that their do not hedge their maize. In this section the hedging decision of maize farmers is discussed in the context of farm and farm owner characteristics. This will be achieved by using multiple cross-tabulations. Lewelle, Lease and Schlabaum (1977:302 cited in Nakana, 2009:104) reported that cross tabulation has the advantage of high information content in presentation.

Table 5.6 indicates the percentage of maize farmers that hedge and that do not hedge in relation to the age category of the maize farm owner. Surprisingly, none of the youngest cohort of farmers hedge at all, while farmers in the age category 30-39 years make up only some 10 per cent (3.2 of 35.5 per cent) of those who actually do hedge. Similarly, none of the farmers over the age of 60 hedged. Farmers in the age group 40 to 60 years old make up almost two thirds of the total number of farmers, and about half of them did hedge their harvest.

Table 5.6: Hedging versus age of the maize farmers

	Age					
	< 30	**30 - 39**	**40 – 49**	**50 – 60**	**>60**	**Total**
	%					
Hedged	0.0	3.2	12.9	19.4	0.0	35.5
Not Hedged	3.2	12.9	9.7	22.6	16.1	64.5
Total	3.2	16.1	22.6	41.9	16.1	100.0

Table 5.7 indicates the hedging decision in relation to a bad experience with hedging that a farmer may have had. It is generally believed that the majority of the maize farmers who do not hedge have had such a bad experience; however the data in this study does not support this conclusion. Most maize farmers who are hedging have had a bad experience in hedging. Notwithstanding, more than half of the farmers (51.61 per cent) do not hedge and have not had a bad experience in hedging.

Table 5.7: Hedging versus bad experience in hedging

	Bad experience	**No bad experience**	**Total**
	%		
Hedged	25.81	9.68	35.48
Not Hedged	12.90	51.61	64.52
Total	38.71	61.29	100.00

It is also instructive to analyse the hedging decision according to whether the farmer rented in land or not. The data in Table 5.8 shows that just more than a third of farmers who rent in land hedge (25.8 out of 71 per cent). This means that whether the farmer rents in land or not does not seem to influence the hedging decision, as this is also the proportion of all farmers who hedge. Nevertheless, Table 5.9 shows that farmers who rent in between 25 and 49 per cent of their land are most likely to hedge.

Table 5.8: Hedging versus rent land

	Rent land	**Not rent land**	**Total**
	%		
Hedge	25.8	9.7	35.5
Not Hedge	45.2	19.4	64.5
Total	71.0	29.0	100.0

Table 5.9: Hedging versus proportion of rented land

	0	**<24**	**25- 49**	**50 – 75**	**>75**	**Total**
	%					
Hedge	9.7	3.2	16.1	3.2	3.2	35.5
Not Hedge	19.4	19.4	22.6	3.2	0.0	64.5
Total	29.0	22.6	38.7	6.5	3.2	100.0

In Table 5.10 the hedging decisions of the maize farmers is analysed in relation to the farm debt ratio. Most of the maize farmers who hedge have a farm debt ratio of 25 to 49 per cent.

Table 5.10: Hedging versus farm debt ratio

	<24	**25 – 49**	**50 – 75**	**75 – 100**	**Total**
	%				
Hedged	9.7	16.1	9.7	0.0	35.5
Not Hedged	29.0	32.3	3.2	0.0	64.5
Total	38.7	48.4	12.9	0.0	100.0

The following discussion looks at the association between the hedging decisions of the maize farmers and their perception of their own marketing skills. From Table 5.11 it is evident that none of the farmers who hedged thought that they had very good marketing skills, while most (29 per cent) thought that they had good marketing skills. This represents 82 per cent (29 of 35.5 per cent) of the farmers who hedged.

Table 5.11: Hedging versus marketing skill of the maize farmers

	Average	**Good**	**Very good**	**Total**
	%			
Hedged	6.5	29.0	0.0	35.5
Not Hedged	22.6	32.3	9.7	64.5
Total	29.0	61.3	9.7	100.0

Table 5.12 shows that virtually all the farmers who hedged had attended a SAFEX course, while there are some farmers (12.9 per cent) who have attended a course but who do not hedge. Table 5.13 in turn shows that all farmers who hedge against price risk understand how the spot price of maize is determined at SAFEX. However, most of the farmers who do not hedge also understand how the spot price is determined at SAFEX, i.e. they understand how the market works.

Table 5.12: Hedging versus SAFEX course

	SAFEX course	No SAFEX course	Total
	%		
Hedged	32.3	3.2	35.5
Not Hedged	51.6	12.9	64.5
Total	83.9	16.1	100.0

Table 5. 13: Hedging versus determination of the spot price

	Determination of spot price	No determination of spot price	Total
Hedged	35.5	0.0	35.5
Not Hedged	54.8	9.7	64.5
Total	90.3	9.7	100.0

Table 5.14 shows data on the relationship between the hedging decision and the belief of the maize farmers about the efficiency of SAFEX. The results show that when farmers believe SAFEX to be efficient, they are more likely to hedge: however, this is fewer than the number of farmers who believe SAFEX is efficient and who do not hedge. There are also farmers who hedge who do not believe that SAFEX is efficient: this could be because the banks insist on hedging as a condition for production loans to farmers.

Table 5.14: Hedging versus SAFEX efficient

	SAFEX efficient	SAFEX not efficient	Total
	%		
Hedged	19.4	16.1	35.5
Not Hedged	41.9	22.6	64.5
Total	61.3	38.7	100.0

Table 5.15 represents the perception of the maize farmers with regards to free market efficiency and their hedging decisions. The results show that when a farmer believes that the free market is efficient, they are only slightly more likely to hedge (22.6 of 54.8 per cent). Nevertheless, when a farmer believes the free market to be efficient, he or she is more likely to hedge.

Table 5.15: Hedging versus free market efficient

	Free market efficient	Free market not efficient	Total
	%		
Hedged	22.6	12.9	35.5
Not Hedged	32.3	32.3	64.5
Total	54.8	45.2	100.0

Table 5.16 indicates the belief of maize farmers towards the cost of hedging with SAFEX, i.e. whether they hedge or not because they think hedging with SAFEX is expensive. It is evident from these data that when farmers believe SAFEX to be expensive they are less likely to hedge, but that more farmers who have hedged believe SAFEX to be expensive than farmers who have not hedged. This could again be the result of the policy of the banks not to lend for production credit unless the farmer is hedged.

Table 5.16: Hedging versus SAFEX expensive

	SAFEX expensive	SAFEX not expensive	Total
	%		
Hedged	12.9	22.6	35.5
Not Hedged	41.9	22.6	64.5
Total	54.8	45.2	100.0

5.5 Hedging versus risk management tools

This section reports on the hedging decisions of maize farmers against alternative risk management tools. It is generally believed that most of the farmers do not hedge because they have alternative price risk management tools at their disposal. These risk management tools include off-farm income, the proportion of off-farm income, insurance, own storage and the use of the local cooperative silo to store maize. The results are discussed below.

Table 5.17 depicts the hedging decisions of maize farmers against off-farm income. The results show that when farmers have off-farm income they are more likely to hedge, and conversely when they do not have off-farm income they are less likely to hedge.

Table 5.17: Hedging versus off-farm income

	Off-farm income	No off-farm income	Total
	%		
Hedged	22.6	12.9	35.5
Not Hedged	19.4	45.2	64.5
Total	41.9	58.1	100.0

We now look at whether the hedging decision of the maize farmers is influenced by whether maize farmers have insurance against unforeseen natural events or not. From 5.18 it is evident that all maize farmers who hedge have insurance to cover their maize. When it comes to the farmers who not hedge, table5.18 indicates that majority of the maize famers are insuring their maize against natural events that can be identified and quantified.

Similarly, farmers who take out insurance seem to be more likely to hedge, but these actions don't tend to be substitutes – there were no farmers without insurance who actually hedged (Table 5.18).

Table 5.18: Hedging versus insurance

	Insurance	No Insurance	Total
	%		
Hedged	35.5	0.0	35.5
Not Hedged	51.6	12.9	64.5
Total	87.1	12.9	100.0

Table 5.19 depicts the relationship between the hedging decision of maize farmers and whether farmers have their own capacity to store their maize after harvesting. The results show that when farmers have their own storage facilities they are far less likely to hedge.

Table 5.19: Hedging versus own/silo storage

	Own silo/storage	No own silo/storage	Total
	%		
Hedged	3.2	32.3	35.5
Not Hedged	19.4	45.2	64.5
Total	22.6	77.4	100.0

5.6 Factors affecting the hedging decisions of the maize farmers

The purpose of this study is to identify factors affecting the hedging decision of farmers in Gauteng significantly. This section will attempt to give answers to questions related to the hedging decision of maize farmers. The probit regression model was run using the SPSS 20 statistical software. As mentioned in Chapter 4 all values of the continuous variables employed in this study were transformed into natural logarithms in order to take care of the problem of difference in units of measurement.

The statistical analysis included a number of tests for collinearities and heteroscedasticity for the empirical model. Heteroscedasticity occurs because of the absence of homoscedasticity. The existence of heteroscedasticity is a major concern in regression analysis because it can invalidate statistical tests of significance that assume that the modelling errors are uncorrelated and normally distributed and that their variances do not vary with the effects being modelled. In order to correct this, the Weighted Least Squares (WLS) was used (Gujarati 2003). The presence of multicollinearity among the independent variables was treated by dropping some of the collinear variables (Source of information, years that maize farmers contracted his/her maize, consideration of rain when hedging, proportion of land that maize farmer rented, bad experience of maize farmer in forward contracting, farm debt ratio, marketing skill, whether the maize farmer has attended SAFEX course/workshop, whether the farmer knows how the spot price is determined, perception of the maize farmer towards free market system and the off-farm income) (Gujarati, 2003). In doing so, some specification error might occur. However this is a risk that has to be taken, as their inclusion could render the model over-specified, and there is also a need to conserve degrees of freedom, given a sample size of 31 observations.

The results of the probit regression model corrected for heteroscedasticity are presented in Table 5.21. Overall the estimated model is highly significant in explaining the hedging decisions of the farmers, with a chi-squared value of 4168.109. Also the model correctly predicted 100 per cent of the observation, which implies that the model is a good fit. It is evident from Table 5.21 that the model reveals a statistically significant impact of various maize farm, owners' characteristics and alternative means of reducing price risk on hedging decisions. The z test was used to test the statistical significance of individual regressors. According to Koutsoyiannis, 1977:83) the z test is based on the standard normal distribution and is applicable only if the population variance is unknown, and provided that the sample is sufficiently large (n>30). The level of significance

chosen is 5 per cent or 95 per cent confidence interval. This means that in making decisions we allow five times out of a hundred to be wrong i.e. to reject the hypothesis when it is actually true.

In binary regression models, goodness of fit is important, but the expected sign of the regression coefficients and their statistical significance are even more important. It is evident from Table 5.21 that the characteristics of maize farms and owners with a statistically significant impact on the hedging decision at the 5 per cent level include gender, age, agricultural qualification, principal decision maker, member of grain industry association, number of grain industry associations the farmer belongs to, period in grain industry, size of the farm, whether the farmer rents in land, proportion of off-farm income and insurance.

Table 5.21: Results of the heteroscedasticity corrected probit regression model

Independent variables	**Dependent variable: hedging decision**				
Parameters	**Estimates (Coefficient)**	**Std. Error**	**z-value**	**Sig (P)**	**Expected signs**
Gender	-0.580***	0.107	-5.439	0.000	
Race	0.2000	0.040	0.511	0.609	
Age (years)	-0.111***	0.023	-4.887	0.000	+/-
Principal occupation	-0.034	0.064	-0.531	0.595	+
Highest education	-0.051**	0.029	-1.747	0.081	+
Agricultural qualification	0.137***	0.040	3.388	0.001	+
Principal decision maker	0.296***	0.082	3.626	0.000	
Member of grain association	-0.651***	0.111	-5.866	0.000	+
Number of grain associations	-0.042***	0.016	-2.635	0.008	+
Radio	-0.042	0.050	-0.842	0.400	+
Period in grain industry	-0.029***	0.004	-6.619	0.000	+/-
Size of the farm	0.000***	0.000	26.493	0.000	+/-
Rent land	0.196***	0.041	4.774	0.000	
Proportion of off-farm income	-0.059***	0.019	-3.149	0.002	-
Insurance	-0.172***	0.059	-2.886	0.004	+
Silo/storage	0.064	0.063	1.020	0.308	-
Use local cooperative silo	-0.051	0.039	-1.293	0.196	-

Chi-Square = 4168.109; df = 199; p-value = 0.00; *** Estimate is significant at the 0.05 level; ** Estimate is significant at the 0.10 level; Estimate is significant at the 0.01 level; Number of valid cases = 217; Probit (P) = $\beta_0 + \beta_i X_i$

The results indicate that the gender of the farmer is negatively associated with their hedging decisions, but because there was only one female farmer in the sample, this aspect will not be addressed further. Furthermore, race was a statistically insignificant variable.

The age of the maize farmers is negatively related to hedging decisions, and is statistically significant at the 5 per cent significant level. Meaning the older maize farmers are more likely to hedge compared to the younger maize farmers. However earlier in the study (section 5.4) it has reported that none of the youngest group of maize farmers hedge. Again in section 5.4 it has been reported that none of the oldest group of maize farmer hedge. This is supported by the results of other studies such as Eldeman *et al*. (1980);Fletcher and Terza (1986); Asplund *et al.* (1989); Shapiro and Brorsen (1989); Musser *et al*. (1996); and Katchova and Miranda (2004) who found that age has a negative association with the adoption of hedging. Most of these studies argue that more experienced farmers have the ability to use the spot market. Barbieri and Mshenga (2008) suggested that it may be that younger farmers are more adaptable and willing to introduce new products and services and those younger farmers may be more entrepreneurial and willing to tolerate the risk associated with innovation.

The highest level of education of the farmer has a negative relationship with hedging. In this case highest education is referred to diploma, degree of post graduate degree. It is also significant at 5 per cent level. These results show that the highly educated are unlikely to hedge. However these results do not support those found in other previous studies like Heierli and Gass (2001); Isengildina and Hudson (2001) and Olaniyan and Okemakine (2008) which found that highest education is an indication of the farmer's ability to process information and cause farmers to have better access understanding and interpretation of information than others. According to Olaniyan and Okemakinde (2008) formal education is highly instrumental and even necessary to improve the production capacity on a nation.

Whether the farmer has an agricultural qualification is positively related to hedging and significant at the 5 per cent level. This is supported by Isengildina and Hudson (2001) who confirmed that the relevant (agriculture) education is an indication of the farmers' ability to process information and cause some farmers to have better understanding and interpretation of information of information than others. This is consistent with the human capital theory, which refers to the stock of skills and knowledge gained through education and experience.

The regression results show that whether the farmer is the principal decision maker on the farm is positively related to hedging. This is also statistically significant at the 5 per cent level. This indicates that if the owner spends all of his/her working time in the farm, it is more likely that he/she will have more chances of forward contracting.

Whether the farmer is a member of a grain or business related association is negatively related to hedging and the relationship is statistically significant. This might be due to majority of the maize farmers do not hedge against price risk (as it is reported in section 5.2). it is also reported that majority of the maize farmers are the members of the grain of business related association *A priori* one would expect the opposite result, because associations provide opportunities to network with different role players in the industry and share information. Bruderl and Preisendorfer (1998) have found that information received from professional networking is often assumed to be more useful, reliable and exclusive and less redundant than information received from formal sources. Furthermore, the number of grain or business related association that a farmer belongs to is also negatively related with hedging behaviour, and is also statistically significant.

The source where the farmer gets their information about the grain industry has a negative relationship with hedging. However radio as source of information is not statistically significant. However it was expected that magazine as medium of information will be positively related to hedging and be significant, as majority of the maize farmers use magazine (see figure 5.5) to get information about the grain industry. Other studies like Barbieri and Mshenga (2008); Groenewald *et al.* (2003) have found a positive relationship between adoption of new strategies and access to information.

The period over which the farm owner has been in the grain industry has a negative relationship with hedging and is statistically significant at the 5 per cent level. This implies that farmers who have been in the grain industry for a long time are not hedging. However in this study it has been reported (figure 5.3) that majority (more than 50 per cent) of the farmers have been in the grain industry for less than 20 years. The reason for a negative relationship might the results of the learning curve of the new maize farmers about the industry as a whole. These results are contrary to expectation, as it was expected that the relationship would be positive as studies (e.g. Davis *et al*., 2005) have found that farmers who have more years of farming experience are willing to hedge larger amount of their crops. However Davis *et al.* (2005) confirmed that a more experienced

farmer may be more accustomed to the previous regime of market regulation, and may therefore forward price at a lower level.

The results indicate that the size of the farm has a positive and statistically significant relationship with hedging - the larger the farm, the higher the chances of hedging. This supports the results of previous studies (Goodwin and Shroeder (1994); Musser *et al.* (1994); Mishra and Perry (1999); Startwelle *et al.* (2000); Ueckermann *et al.* (2008); Katchova and Miranda (2004) which found that large farms have a greater preference for hedging. Sartwelle *et al.* (2000) argued that larger farms have economies of scale in terms of learning how to use marketing tools and collecting marketing information.

Whether the farm owner rents land is also positively related to hedging and is statistically significant at the 5 per cent level. These results were as expected – it is believed that in order to secure income or reduce risk she or he must hedge. Hedging can assist farmers to secure funds as it can be used as guaranteed income.

The proportion of the owners' income that is earned off-farm is also negatively related to hedging, and is statistically significant. This indicates that as the proportion of off-farm income increases the maize farmer becomes less likely to hedge. This confirms the finding of Velandia *et al.* (2009) who found that farm owners with a low level of off-farm income tend to hedge. Turvey and Baker (1989) and Gabriel and Baker (1980) also suggested an inverse relationship between off-farm income and hedging as off-farm income is a substitute for hedging

In the same vein, whether the farmer insures his/her crops against natural events that can be identified and quantified is also negatively related to hedging and statistically significant at the 5 per cent level. This shows that maize farmers are using insurance as an alternative risk management tool. This confirms Coble *et al.* (2000) who found that farmers who use insurance are more likely not to hedge.

5.7 Chapter summary

This chapter provided an analysis of the results relating to the maize farm and farm owner characteristics that influence the hedging decisions of maize farmers in Gauteng province. The results show that only 35 per cent of the farmers indicated that they hedge. Most of the farmers have

been in the maize industry since before the deregulation of agricultural markets, and are members of at least 3 business associations.

The chapter identified factors affecting the hedging decision of the maize farmers. The probit regression model was used to estimate those factors. The probit regression model was run using the SPSS 20 statistical software to identify those factors that are significant. The 5 percent level of significance was adopted. It has been found that not variables in table 5.21 are statistically significant at 5 percent level and others were omitted because challenges that they may cause in the model. It has been found that only gender, age, highest education, agricultural qualification, principal decision maker, member of grain association, number of grain association, period in the grain industry, size of the farm, whether the farmer rent land, proportion of off-farm income and insurance are statistically significant at 5 per cent level.

CHAPTER 6: CONCLUSION

6.1 Introduction

The main objective of the study was to determine the factors that affect the hedging decisions of the maize farmers in Gauteng. This objective was considered very important because it is believed that these factors will facilitate the destination between attributes (both for maize farm and owner) that are more important in terms of the hedging decisions. The second objective was to determine the adoption rate of the risk management tool by farmers. This objective is also important to give indication of whether farmers are using the instrument that was developed for them to protect themselves against price risk. The other objective was to identify alternative means of reducing price risk that the farmers can use to protect themselves against price risk.

6.2 Adoption rate of hedging against price risk

In the case were the objective was to determine the adoption rate of price management tool, it has been found that only 35 per cent of the maize farmers that responded hedge against price risk. This shows that most of the maize farmers are not utilizing price risk management tools. Other studies have found that even after 15 years of deregulation of agricultural markets, farmers are still not protecting themselves against price risk. In this case the might be due to the learning curve of the farmers who entered the maize industry after deregulation of the maize value chain in South Africa. The following section discusses factors that are believed to influence hedging decisions.

6.3 Characteristics affecting hedging decisions of maize farmers

In the case were the objective was to identify factors affecting the hedging decision, it has been found that most of the farmers who hedge are between the age of 50 to 60 years. The results show that no farmer at the oldest group hedge against price risk. Even at the youngest maize farmer group, no farmer hedge against price risk. This shows that farmers who hedge are at the middle age (more than years but less than 60 years of age). The reason for this might be that youngest maize group farmers are still at the learning curve of the industry, while the older maize farmers group do not hedge because their used to the old regime, where their guaranteed the maize price during the production cycle. When hedging is associated with bad experience, it has been found that most of the farmers who hedge have bad experience in hedging where their think they have lost some profit.

However most of them who don't hedge do not have bad experience in hedging. This shows that most of the farmers do not hedge because they don't believe of understand how market works.

When edging is associated with land that is rented, it has been found that, most of the farmers who rent land hedge; these results indicate that maize farmers who rent land want to protect their income. Also most of the farmers who hedge, rank themselves as having good marketing skill. This shows that maize farmers have confidence in their marketing skill. Most of the farmers who hedge have attended the course that explain how SAFEX works and how the spot price is determine at SAFEX. This indicates attendance of courses enhance the understanding of farmers.

When it comes to perception of the farmers against hedging, it has been found that most of the maize farmers who hedge against price risk believe that SAFEX and free market is efficient to determine the price. This shows that the farmers understand how SAFEX works. However it has been found that all farmers who hedge do not believe that free market gives farmers fair deal. This is the results that most of the maize farmers have been in the grain industry before deregulation of the agricultural market, where the price was fixed by government during the production stage and farmers were subsidized.

In this study probit regression model was used to identify factors affecting the hedging decisions of maize farmers in Gauteng province. The characteristics of maize famer with a statistically significant impact on hedging decision include gender, age agricultural qualification, principal decision maker, member of grain association, number of grain association and period in the grain industry. The characteristics of maize farms that are statistically influence the hedging decision include size of the farm and land that is rented. This confirms the fact that business performance is influenced by both owner and farm characteristics. Farm characteristics help farms in the mobilization of resources like information, technology and marketing.

6.4 Alternative means of reducing price risk

The third objective of the study was to identify the alternative means of reducing price risk. From the study it has been found that most of the maize farmers do not have off farm income. Only 42 per cent of the maize farmers have indicated they have off-farm income. This result indicates that most of the farmers derive income from on farm activities. Majority of the maize farmers who hedge

derive their income from off-farm activities. This indicates that most of the farmers have off income to supplement their on farm income.

The study has found that majority of the farmers have insurance to protect themselves against unforeseen natural events. All farmers who hedge have some form of insurance (yield insurance) to protect their crops against natural disaster. This shows that farmers are not just concerned about price risk, but also production risk that can be caused by natural disasters. It also has been found that most of the farmers do not have the means to store their maize at their own premises. This indicates that farmers do not have means to store their own maize after harvesting period. Probit model was employed to identify factors that are believed to be alternative means of reducing price risk. It has been found that insurance and off-farm income are statistically significant a 5 per cent level. This confirms that alternative means of reducing price risk are important towards hedging decision of the farmers.

6.5 Recommendations and further studies

- The study has found that most maize farmers are not hedging against price volatility. Therefore this shows that farmers must be made aware of the importance of forward contracting his/her crop. This can be achieved through training, practical training is important because it is well known that people can lean more by practicing.

- There are many studies other external factors that might influence the hedging decisions of the farmers which were not accounted for in this study. These may include the location of the maize farmers, the type of the maize (yellow or white), distance to millers or silo, etc. A study that takes into account all these factors would be a valuable contribution to the existing literature on the subject.

- The studies that focus on the relationship between agricultural sector and the rest of the economy must be conducted in other to advice policy makers and decision makers. Price of maize is influenced by the rest of economy as it is internationally traded. This kind of study can have practical value to policy makers, decision makers and farmers.

- Another set of results may be of interest to policy makers. This study reveals a negative relationship between hedging and the period in which the maize farmer has been in the grain

industry. This finding suggests that farmers do not understand the new system where the price is not guaranteed at the production season.

- This study also identified certain producer characteristics, which increase the probability of hedging. For example owner of a large farm. These results can be used by educators to better tailor their training programs to the specific needs of the audience they address. Also whether the maize farmer has the highest education is negatively related to hedging. While the maize farmer who has agricultural qualification is positively related to hedging. This confirms that training of farmers should be tailor made for them to meet the specific needs.

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Annexure 1: Covering letter and Questionnaire

Dear Maize Farm Owner/Manager

The Department of Agricultural Economics at the University of Stellenbosch is appealing for your assistance. The assistance requested is in the form of a few minutes of your time.

We are busy conducting a study aimed at investigating factors affecting hedging decisions of farmers. The overall aim of the study is to advance an understanding of factors that affect the hedging decisions of farmers. Policy makers, commodity trader and researchers as well as other stakeholders want to know why futures market has failed to attract greater farmers' participation. This study attempts to investigate why farmers hedge or not. Role player will be able to use the results of this study to educate maize producers and processors in the use of forward pricing methods in price risk management, and consequently will also add more value to industry body of knowledge.

What we would like to ask you is to help us with the collection of valuable data that we need to successfully conduct this study. We have included a questionnaire that we would like you to fill and that will take no more than fifteen minutes of you time to answer. We humbly request you to complete it as accurately as possible.

Should you have any question or query, please do not hesitate to contact us through the following:

Cell : 083 731 1273
Fax : 0865404463
E-mail : maineo@gmail.com

Thank you for the courtesy of your assistance

Yours Sincerely

Maine Mofokeng
Study Leader: Prof Nick Vink – University of Stellenbosch (Agricultural Economics)

MAIZE STUDY QUESTIONNAIRE

Section A: Owner/Principal shareholder and farm characteristics

1. Gender:				Male	Female
2. Race:	White	African	Coloured	Indian	
3. Age:	< 30	30 – 39	40 – 49	50 – 60	> 60
4. What is your principal occupation?				Farming	Other
5. Highest education qualification completed	Grade 12 or lower	Technicon/College diploma or degree	University degree	Postgraduate degree	
6. Do you have an agricultural degree, Diploma or certificate?				Yes	No
7. Is the owner/principal shareholder the principal decision-maker?				Yes	No
7.1. If no, who makes the decisions?.....					
8. Is the owner/principal shareholder a member of any business or grain association?				Yes	No
8.1 If yes, how many?.....					

9. How do you get information about maize/grain?	Radio	TV	Magazine	SMS	Internet	Others
10. Do you ever forward contracted your maize crop against price risk?					Yes	No
10.1. If yes in which year(s)	2004	2005	2006	2007	2008	2009
10.2. If yes to 1, do you consider rain before you forward contract?					Yes	No

11. How long you have been in the maize/grain industry?				
12. What is the total size of your farm?				
13. Do you rent in part or all of your land?			Yes	No
13.1 If yes, what is the proportion of the farmland that is rented?	<25%	25-49%	50-74%	75-100%

14. What is the number of hectares that you planted to maize in the following years	2004	2005	2006	2007	2008	2009 .....

15. Have you had any bad experiences in forward contracting your crop (maize)?				Yes	No
16. What is your farm debt ratio (Farm debt ratio= [farm debt/farm assets] x100)?	< 24%	25 – 49%	50 – 75%	>75%	

17. How do you rank your marketing skill	1 very Poor	2 Poor	3 Average	4 Good	7 Very Good

21. Have you ever attended a SAFEX course/workshop?	Yes	No
18. Do you know how the spot price of maize is determined on SAFEX?	Yes	No
19. Do you think SAFEX is efficient in managing price risk?	Yes	No
20. Do you think the free market is efficient	Yes	No
21. Do you think the free market gives farmers a fair deal?	Yes	No
22. Do you think forward pricing with SAFEX is expensive?	Yes	No

Section B: Alternative risk management tools

1. Do you have off-farm income?			Yes	No
1.1 If yes, what is the proportion of your total income that is generated from off-farm income?	<24%	25-49%	50-75%	>75%

2. Do you insure your crops against natural events that can be identified and quantified (e.g. hail, drought, fire, wind, etc)	Yes	No
3. Do you have your own silo/storage?	Yes	No
4. Do you use the local co-operative silo where you store your maize?	Yes	No

Any further comment(s)

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Thank you very much for your time and effort